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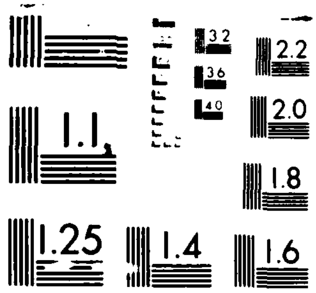

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AD-A179 191

DETAILED PROJECT REPORT

AND

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ENVIRONMENTAL ASSESSMENT

ON

Upper Gordons Creek

URBAN FLOOD DAMAGE REDUCTION MEASURES
AT HATTIESBURG, MISSISSIPPI

US Army Corps of Engineers
Mobile District
South Atlantic Division

SEPTEMBER 1986

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A Detailed Project Report (DPR) was prepared to determine the need for Federal participation in a project to modify the flood conditions in Hattiesburg, Miss. The studies presented in this report cover the Gordons Creek drainage basin, its flood problems, and the potential for solving such problems. All reasonable alternative plans for flood damage reduction were considered. Although the study concentrated on damages associated with flooding, other areas of water resource planning were also investigated, which were: socio-economic profile,

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fish and wildlife resources, and recreation potential.

Field investigations were made to develop assessments of flood damages, soil conditions, and flood control measures which would be necessary to alleviate flooding problems. Stream discharges in the basin were determined by use of an HEC-1 computer model to simulate the rainfall - runoff process. The water surface profiles were developed through the use of an HEC-2 computer model.

The report has a Main Report section which includes the Environmental Assessment and which is supported by appendices for Socio-Economic Investigations, Engineering Investigations, Plan Formulation, Environmental Investigations, and Public INvolvement and Coordination.

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2288
MOBILE, ALABAMA 36628

REPLY TO
ATTENTION OF:

UPPER GORDONS CREEK

HATTIESBURG, MISSISSIPPI

DETAILED PROJECT REPORT

AND

ENVIRONMENTAL ASSESSMENT

SEPTEMBER 1986

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SYLLABUS

This report presents flood control studies of Upper Gordons Creek at Hattiesburg, Mississippi. The Gordons Creek basin drains about 75 percent of the City of Hattiesburg. The investigation considered the potential for reduction of flood damages along Gordons Creek from Broad Street at mile 2.5 upstream to the headwaters of the main creek and the largest tributary in the basin.

The SPF flood plain contains a total of 1,151 structures and the total average annual damages are estimated to be $1,426,450 with October 1985 prices and development. Damage reduction measures consisting of channel enlargement, diversion of flood waters into another basin, flood plain evacuation, increased flood warning capability were examined.

The recommended plan consists of an excavated channel with grassed banks on a slope of 1 vertical on 3 horizontal combined with flood plain evacuation. The plan has four segments: (1) a 40 foot bottom width channel from Broad Street to Hardy Street; (2) nine residences to be evacuated at Brooklane Street; (3) a 30 foot bottom width channel from U.S. Highway 11 (Broadway Drive) to South 28th Avenue; and, (4) a 20 foot bottom width channel from South 28th Avenue to the intersection of South 40th Avenue and Lincoln Road. Riprap will be provided at bridge crossings and in curves on the banks where channel work is done. The alignment and bottom profile of the existing creek will be maintained except at two locations where bridges will be replaced and the channel straightened in the immediate area of each bridge. The plan includes a right-of-way of 15 feet on each side of the channel for most of the project length. In selected areas the right-of-way is increased to 30 feet to enhance the preservation of wooded areas along the creek.

An existing Corps of Engineers project consisting of clearing and snagging and channel enlargement extends from the mouth of Gordons Creek upstream 2.5 miles to Broad Street. Because the selected plan increases damages along the existing project, a mitigation component was added to the project. The selected measure consists of flood proofing 21 residences and one business to the 100-year flood elevation after the plan is implemented.

The estimated total first cost for the project is $6,619,000. Of this amount $2,997,700 would be Federal cost and $3,621,300 would be non-Federal. Based on prices current in October 1985, interest at 8-5/8 percent and a 50-year project life, the total annual charges are $636,600. Included in the non-Federal annual cost is $14,000 for operation and maintenance. Average annual benefits which will be realized for the project are $1,082,800, and the project B/C ratio is 1.7.

Estimated Investment Cost and Annual Charges for the NED Plan
October 1986 Price Levels, 8.875% Interest Rate

INVESTMENT COST	
Total Project First Cost	$6,619,000
Interest During Construction	498,200
TOTAL PROJECT INVESTMENT COST	$7,117,200
ANNUAL CHARGES	
Interest	$631,650
Amortization	9,130
Operation and Maintenance	14,000
TOTAL PROJECT ANNUAL CHARGES	$654,780

Breakdown of Benefits for the NED Plan

Total Flood Damages (Existing Conditions)	$1,527,300
Flood Damage Reduction Benefits	924,000
Insurable Flood Losses (Evacuation)	36,200
Affluence Benefits	65,900
Insurance Overhead Reductions	19,100
Benefits for Mitigation of Induced Damages	59,200
Total Benefits	$1,104,400
Percent Damages Removed	72.3%

Project Feasibility for the NED Plan

Benefits	$1,104,400
Costs	$654,780
Net Benefits	$449,620
B/C	1.7

MAIN REPORT

DETAILED PROJECT REPORT

ON

UPPER GORDONS CREEK

AT

HATTIESBURG, MISSISSIPPI

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DETAILED PROJECT REPORT

UPPER GORDONS CREEK

HATTIESBURG, MISSISSIPPI

THE STUDY AUTHORITY, PURPOSE AND SCOPE

PURPOSE AND AUTHORITY

The City of Hattiesburg, Mississippi has frequently suffered damages caused by flooding along Gordons Creek. In the last 40 years, five major floods have occurred on Gordons Creek. They happened in 1947, 1957, 1961, 1980, and 1983. The April 1983 flood emphasized the severity of the flood problems in the basin and gave impetus to the need for solutions. The flood caused runoff flows that were slightly higher than the estimated 100-year flood heights for most of the stream. From rainfall and high water marks below Broad Street, the flood was estimated to be approaching the 500-year event in that area. Total damages from the storm were estimated to be about 14 million dollars.

This study was undertaken by the Mobile District at the request of Commissioner G. D. Williamson (currently Mayor of Hattiesburg) to determine the need for Federal participation in a project to modify the flood conditions. Investigations have been performed under the continuing authority provided to the Chief of Engineers in Section 205 of the Flood Control Act of 1948, as amended.

SCOPE OF THE STUDY

The studies presented in this report cover the Gordons Creek drainage basin, its flood problems, and the potential for solving such problems. Gordons Creek has an existing Federal project for the reduction of flood damages from its mouth upstream 2.5 miles to Broad Street. Therefore, this study focused on the potential for flood damages along Gordons Creek from Broad Street upstream to the vicinity of Interstate 59, a distance of about 5.0 miles. Also included is a tributary from its mouth at Kamper Park upstream to South

Thirty-seventh Avenue, about 1.8 miles. One measure investigated for reducing the flooding on Gordons Creek was the diversion of flood water into Burketts Creek and limited data was also collected on a part of the Burketts Creek Basin. The study area is shown on Plate No. 1.

All reasonable alternative plans for flood damage reduction were considered. The selection of the recommended plan was made after considering many decision factors including those expressed by concerned Federal, State, and Local Government agencies and the local public. Although the study concentrated on damages associated with flooding, other areas of water resource planning were also investigated. Such investigations included: a socio-economic profile, fish and wildlife resources, and recreation potential.

PRIOR STUDIES, REPORTS AND EXISTING WATER PROJECTS

PRIOR STUDIES AND REPORTS BY THE CORPS OF ENGINEERS

In April 1951, a study was initiated on Gordon Creek under the authority of Section 212 of the Flood Control Act of 1950. On 14 October 1953, the Mobile District Engineer submitted a report recommending enlargement of a 2-mile-long reach of the channel beginning at its mouth and extending upstream through the business district of the City. However, in July 1956, the project was deauthorized by the Chief of Engineers because necessary rights-of-way could not be obtained by local interests.

In September 1966, the Mayor of Hattiesburg requested assistance to alleviate flooding on Gordons Creek and study was begun under the authority of Section 205 of the Flood Control Act of 1948, as amended. The study was delayed several times for various reasons during the next several years, but in August 1976 the Mobile District Engineer completed a Detailed Project Report recommending construction of a flood control project on the lower end of the creek.

Hydrologic and hydraulic data in the August 1976 Detailed Project Report were developed for conditions existing in 1974. Storm damage relationships in the report were developed using January 1974 basin development and price levels.

Damages to development existing in 1974 in the upper basin were significant but insufficient to justify a structural solution at that time. Therefore, no improvement in the upper basin was recommended in the Detailed Project Report. However, in April 1980 a major flood caused damages to homes and business in the upper basin to the extent that Hattiesburg was declared a major disaster area. In December 1981, the Mobile District completed a reconnaissance investigation and report on flooding problems along Gordons Creek upstream of the project area outlined in the Detailed Project Report. The reconnaissance report described the severity of the problems, identified a potential solution, and recommended detailed studies of the flooding along the upper portion of the creek.

In August 1983, the Mobile District completed a Detailed Project Report on the Leaf and Bowie Rivers in the vicinity of Hattiesburg and Petal Mississippi. The report was completed as a part of the overall review study authorized by Congress in 1974 to review the water and related land resources of the Pascagoula River basin. The Leaf and Bowie Report recommended flood control actions that would reduce flood heights on the Leaf River in Hattiesburg. Construction of the project is underway at this time.

EXISTING WATER PROJECTS

Federal construction of a flood control project on the lower end of Gordons Creek was initiated in June 1979. The work provides for reduction of flood damages from the mouth of the creek upstream 2.5 miles to the Broad Street Bridge crossing. The project consists of clearing and snagging from the creek's confluence with the Leaf River upstream to Bay Street and channel widening to a 40-foot bottom width between Bay Street and Broad Street. The Federal portion of the project was completed in February 1980. The local sponsor's portion was completed in 1984 after the relocation and alteration of certain buildings and utilities.

OTHER PRIOR STUDIES AND REPORTS

In 1969 a flood insurance study for Hattiesburg was completed in two parts. One report was prepared by the U.S. Geological Survey, dated January 1969, and titled "Flood Hazard Study for Hattiesburg, Mississippi-Leaf and Bowie River". This report was completed with funds from the Department of Housing and Urban

Development's Federal Insurance Administration. It presented information on the flood hazards at Hattiesburg. Data prepared in the report included flood heights, as well as an inventory of the residences located in the flood plain. The data and engineering analyses developed in this flood hazard study were used as a basis for a second report prepared by the Corps of Engineers Mobile District dated September 1969, and titled "Flood Damage Study for Hattiesburg, Mississippi-Leaf and Bowie Rivers". This second report was also completed with funds from the Federal Insurance Administration and included: a damage survey of the flood plain structures and their contents; establishment of the depth-percent damage relationship for each class of structure and its contents; and determination of the average annual flood damage rates, deductible rates, and premium risk insurance rates for flood plain structures and their contents.

Legal appeals for change to the January 1969 study by the city of Hattiesburg resulted in a restudy by the U.S Geological Survey, again using funds from the Federal Insurance Administration. In March 1979, the preliminary mapping was released to the city for review, but once again resulted in appeals by the city relating to areas on the lower reaches of Gordons Creek, and some refinements were made in the floodway alignment for the Leaf River in the vicinity of the Hardy Street bridge. The Washington based firm of Bernard Johnson, Incorporated, modified the March 1979 study, with funds from the Federal Emergency Management Agency's Insurance and Mitigation Division, and released revised preliminary mapping for Hattiesburg on 20 August 1981. After this August 1981 mapping was received by the City, some very minor appeals were raised. Relative to these new appeals, Bernard Johnson, Incorporated, again revised the flood plain mapping. Following these corrections, the flood Insurance Rate Maps (dated 15 April 1982) were turned over to the city of Hattiesburg. Since that time this mapping has been revised, and final approved copies are dated 2 August 1982.

DESCRIPTION OF THE STUDY AND STUDY AREA

EXTENT OF STUDY

Field investigations were made by Mobile District personnel to develop assessments of flood damages, soils conditions, and flood control measures which would be necessary to alleviate flooding problems.

Geographic data for hydrologic and hydraulic studies were taken from (1) U.S. Geological Survey Quadrangle maps, (2) cross sections made by the U.S. Geological Survey for the Flood Insurance Study completed in 1969, (3) supplemental cross sections made by Mobile District personnel, and (4) City of Hattiesburg topographic maps with two-foot contour intervals at a scale of 1:2400. Stream discharges in the basin were determined by use of an HEC-1 computer model to simulate the rainfall-runoff process. The water surface profiles were developed through the use of a HEC-2 computer model. The results were calibrated by comparison to observed flood heights from the April 1983 flood. More detailed discussion of the hydrologic and hydraulic analyses including sediment sampling and available soils data are contained in Appendix 2.

Average annual flood damages were determined by using the Expected Annual Flood Damage (EAD) computer program developed by Corps of Engineers Hydrologic Engineering Center at Davis, California. Additional discussion regarding derivation of damages is contained in Appendix 1.

PHYSICAL SETTING

The city of Hattiesburg is located in Forrest County and lies in the Pascagoula River basin at the Leaf and Bowie Rivers in Southeastern Mississippi. Hattiesburg is the county seat of Forrest County, however, a small portion of the corporate boundary lies within Lamar county. The City is about 115 miles northeast of New Orleans, Louisiana, 85 miles southeast of Jackson, Mississippi (the State Capitol), and 97 miles northwest of Mobile, Alabama.

STREAM CHARACTERISTICS

Gordons Creek rises in Lamar County and flows generally eastward for 7.8 miles through Forrest County to enter the Leaf River from the right bank.

Approximately 7.4 miles of the creek is within the corporate boundary of Hattiesburg. It drains about 75 percent of the City and has a total drainage area of approximately 10 square miles. The uppermost 3-mile-long reach of the creek traverses newly developed residential subdivisions, commercial properties and major shopping centers. Downstream from this reach, the creek runs through the older established residential areas, downtown Hattiesburg and a 1-mile-long reach of undeveloped bottomland adjacent to the Leaf River. Flood flows on the creek are impeded by numerous railroad crossings, street crossings, pipeline crossings, buildings, and other improvements which extend from the edge of the flood plain to the channel banks. In addition to impeding flood flows, the development has reduced the amount of pervious areas in the watershed and increased the quickness of storm runoff entering the creek.

HUMAN AND INSTITUTIONAL RESOURCES

The flood plain consists of all or part of six census tracts with a total population of 19,536 as of the 1980 Census. This represents almost 50 percent of the total population of Hattiesburg that could be affected by flooding from Gordons Creek. The 1980 Census for the city indicates a 6.7 percent increase in population and a 28.2 percent increase in housing units from the 1970 Census. Additional demographic data are available in Appendix 1.

FLOOD DAMAGES

The potential recurring flood losses along Upper Gordons Creek were converted to average annual losses by correlation of elevation-damage and elevation-frequency relationships to damage-frequency data. The flooding on the main creek was analyzed in 13 reaches and a tributary that enters the creek at Kamper Park was divided into 5 reaches. Table 1 presents a breakdown of the average annual damages by reach and damage category for Gordons Creek upstream of the existing project. The designated reaches are identified on Plate 1. The flood plain contains a total of 1,151 structures and the total average annual damages are estimated to be $1,342,000 with November 1982 prices and development, or $1,426,450 at October 1985 prices. When damages in reaches 1 and 2 on the Main Creek are included average annual damages in the basin are $1,499,100 at October 1985 prices.

TABLE 1
Annual Damage by Reach
(Values in $1,000 November 1982 Prices and Development)

Reach	Residential Structures	Commercial Structures	Public	Other 1/	Total
MAIN CREEK 2/					
3	3.9	0.0	0.4	0.4	4.7
4	275.5	0.0	0.6	34.1	310.2
5	2.5	0.0	0.8	0.4	3.7
6	30.2	0.0	0.0	3.7	33.9
7	25.3	0.1	0.0	3.3	28.7
8	0.0	125.6	0.0	15.5	141.1
9	4.0	77.5	0.2	10.1	91.8
10	0.0	0.6	0.2	0.1	0.9
11	246.7	0.0	1.3	30.5	278.5
12	146.4	0.3	0.0	18.1	164.8
13	170.2	0.0	0.3	21.0	191.5
TRIBUTARY					
1	25.8	0.0	0.0	3.1	28.9
2	2.2	0.0	0.0	0.3	2.5
3	26.1	0.0	0.0	3.2	29.3
4	6.5	12.0	0.0	2.3	20.8
5	9.5	0.0	0.0	1.2	10.7
TOTAL	974.8	216.1	3.8	147.3	1,342.0 3/

1/ Other damages include damages to streets, communications lines, and utilities.

2/ Reaches 1 and 2 consist of the area below Broad Street.

3/ As shown in Table 2, this number was used in screening alternative plans, whereas in Table 3, an updated number reflecting October 1985 prices was used to evaluate the final plans.

PLAN FORMULATION

In formulating a plan, it was necessary to develop planning objectives, identify and address problems, define needs of the study area, and develop alternative plans to satisfy the objectives. Interested individuals and agencies were kept informed and participated in the study process.

PUBLIC INVOLVEMENT AND COORDINATION

The Mayor, City Commissioners, and the citizens of Hattiesburg participated in the study. Coordination during the study has been maintained with the U.S. Fish and Wildlife Service, and the Mississippi Historic Commission. The views of these agencies are provided elsewhere in this report. An initial stage public meeting was held to give local interests an opportunity to express their concerns and two public workshops were held to present the study results and to determine the preferences of the affected local people and other interests. Additional information on workshops and their findings are contained in Appendix 5.

FUTURE WITHOUT PROJECT CONDITIONS

The conditions within the Upper Gordons Creek flood plain are expected to remain stable for the foreseeable future. Due to the density of existing development, no real future growth is anticipated; however, the relative value of the present development may increase due to inflation. Affluence factors were applied to the value of residential contents to allow for an increase in flood damages due to inflation. For the purpose of comparison to flood damage reduction plans, these increases in content value were reduced to an equivalent average annual figure for November 1982 prices and development. The period of analysis was 50 years and the remaining physical life of all structures was estimated to be 50 years. Specifically, all structures are expected to be continually maintained or repaired to preflood conditions as circumstances dictate. The interest rate is set at 8-5/8 percent. The total average annual flood damages for future without project conditions on Upper Gordons Creek is $1,438,240 for November 1982 prices and development and $1,489,870 for October 1985 prices. Future conditions were not computed for lower Gordons Creek since the existing project affords protection in that area.

STUDY OBJECTIVES

The detailed objectives selected to guide the planning process during plan formulation for Upper Gordons Creek are listed below:

a. Reduce flood damages;

b. Minimize induced flood damages along the existing project on Gordons Creek;

c. Preserve and enhance community cohesion;
d. Maintain and enhance the integrity of the local economy;
e. Maintain and increase the quantity and/or quality of fish and wildlife habitat;
f. Maintain or improve water quality;
g. Contribute to outdoor recreation opportunities consistent with local needs and financial limitations;
h. Minimize adverse effects on cultural resources;
i. Reduce health hazards due to flooding;
j. Minimize anxieties and concerns over flood threats; and,
k. Minimize disruptions to the flow of automobile and rail traffic.

PLANNING CONSTRAINTS

The flood damage reduction plans were formulated and evaluated under technical criteria for engineering, economic and environmental constraints as follows:

a. All plans must have net national economic development benefits unless the deficiency is the result of benefits foregone or additional costs incurred to contribute to protection of environmental quality;
b. Protective works must be capable of being constructed and must be designed for the project life or be replaced with like structures;
c. Each element of an alternative plan must provide benefits at least equal to its cost;
d. The benefits and costs must be based on comparable economic terms;
e. Annual benefits and costs are based on a 50-year project life and the current interest rate for Federal projects; and,
f. Nonstructural solutions should be economically feasible, implementable, and acceptable to local interests and to the individuals impacted by that solution.
g. The recommended plan must be compatible with the comprehensive development plan of the City of Hattiesburg;

FORMULATION METHODOLOGY

Development of alternative plans for this study followed a three-stage process: (1) determine possible solutions; (2) develop alternative plans; and, (3) develop the selected plan. Each stage of the plan formulation process considered the four functional planning tasks: problem

identification, development of alternatives, impact assessment, and evaluation. A detailed discussion of plan formulation is presented in Appendix 3.

POSSIBLE SOLUTIONS

In the course of this study, various alternatives for flood protection have been considered for solving the flooding problems along Gordons Creek. These alternatives are divided into the two broad categories of nonstructural and structural measures. Nonstructural measures include zoning, subdivision regulations, building codes, flood proofing of both individual buildings and single land tracts, flood forecasting, and evacuation of flood plain areas. Structural measures include reservoirs, stream diversions, clearing and snagging, channel modifications, levees, and flood walls.

ALTERNATIVE PLANS

Based on characteristics of the study area and concerns expressed by the citizens of the area, 15 alternative plans were formulated for consideration. These plans were divided into four categories: diversion of flood waters, channel enlargements, flood plain evacuation, and increased flood warning capabilities. A detailed detailed discussion of these plans is presented in Appendix 3. A summary of the plans by category is as follows:

1. Four plans for a diversion of flood waters into the head waters of Burketts Creek were developed considering various options for length and alignment. The two least expensive plans were examined in detail. Because of unfavorable benefit-to-cost ratios for the plans, the remaining two plans were not evaluated.
2. Six channel enlargement plans were formulated with varying lengths of work. The optimum length was identified and then two additional plans were formulated to investigate alternate channel widths for the identified length.
3. Two nonstructural plans were formulated. One involved evacuation of all structures affected by the 10-year frequency flood and the other involved partial evacuation of the 10-year flood plain to remove the maximum number of feasible structures in flood plain areas along the creek.
4. One plan was developed for additional flood warning capability in the basin.

The most practical of these alternative plans were selected and presented at a public workshop in January 1985. A summary of comparative data relating to the alternative plans is given in Table 2. Annual benefits and costs are based on an interest rate of 8-1/8 percent and November 1982 price levels.

TABLE 2
Upper Gordons Creek Plan Formulation Results
(November 1982 Prices and Development)

Measure	Plan	Existing Damages $1,000	Annual Benefits $1,000	Annual Costs $1,000	Net Benefits $1,000	B/C	Remaining Damages $1,000	Damages Removed %
UPPER GORDONS CREEK								
Diversion	11	1,341.99	Not Evaluated					
	12	1,341.99	Not Evaluated					
	13	1,341.99	Costs Exceed Benefits by a Considerable Amount					
	14	1,341.99	Costs Exceed Benefits by a Considerable Amount					
Channel Enlargement	21	1,341.99	238.59	146.14	92.45	1.6	1,103.40	17.8%
	22	1,341.99	469.37	327.63	141.74	1.4	872.62	35.0%
	23	1,341.99	664.74	455.92	208.82	1.5	677.25	49.5%
	24	1,341.99	923.72	654.80	268.92	1.4	418.27	68.8%
	25	1,341.99	972.50	817.40	155.10	1.19	369.49	72.5%
	26	1,341.99	989.11	934.20	54.91	1.06	352.88	73.7%
	24A	1,341.99	873.35	601.28	272.07	1.5	468.64	65.1%
	24B	1,341.99	859.16	553.07	306.09	1.6	482.83	64.0%
Evacuation	31	1,341.99	682.15	1,175.48	-493.33	0.6	659.84	50.8%
	32	1,341.99	188.79	126.43	62.35	1.5	1,153.20	14.1%
Flood Warning	41	1,341.99	Not Practical					
IMPACT ON THE EXISTING PROJECT								
Channel Enlargement	21	70.07	(15.39)				85.46	
	22	70.07	(29.69)				99.76	
	23	70.07	(29.54)				99.61	
	24	70.07	(30.78)				100.85	
	25	70.07	(35.96)				106.03	
	26	70.07	(36.37)				106.44	
	24A	70.07	(26.52)				96.59	
	24B	70.07	(26.55)				96.62	
Evacuation	31	70.07	0.00				70.07	
	32	70.07	0.00				70.07	

TABLE 2 (Continued)
Upper Gordons Creek Plan Formulation Results
(November 1982 Prices and Development)

Measure	Plan	Existing Damages $1,000	Annual Benefits $1,000	Annual Costs $1,000	Net Benefits $1,000	B/C	Remaining Damages $1,000	Damages Removed %
UPPER GORDONS CREEK COMBINED WITH THE EXISTING PROJECT								
Diversion	11	1,412.06	Not Evaluated					
	12	1,412.06	Not Evaluated					
	13	1,412.06	Costs Exceed Benefits by a Considerable Amount					
	14	1,412.06	Costs Exceed Benefits by a Considerable Amount					
Channel Enlargement	21	1,412.06	223.20	146.14	77.06	1.5	1,188.86	15.8%
	22	1,412.06	439.68	327.63	112.05	1.3	972.38	31.1%
	23	1,412.06	635.20	455.92	179.28	1.4	776.86	45.0%
	24	1,412.06	892.94	654.80	238.14	1.4	519.12	63.2%
	25	1,412.06	936.54	817.40	119.14	1.15	475.52	66.3%
	26	1,412.06	952.74	934.20	18.54	1.02	459.32	67.5%
	24A	1,412.06	846.83	601.28	245.55	1.4	565.23	60.0%
	24B	1,412.06	832.61	553.07	279.54	1.5	579.45	59.0%
Evacuation	31	1,412.06	682.15	1,175.48	-493.33	0.6	729.91	48.3%
	32	1,412.06	188.79	126.43	62.35	1.5	1,223.27	13.4%
Flood Warning	41	1,412.06	Not Practical					

PLAN ANALYSIS

Analysis of the alternative plans indicates the the channel enlargement plans are the most successful in significantly reducing flood damages. From the data in Table 2, it was determined that Plan 24B provided the highest net economic benefits. It also reduced average annual flood damage in the basin by about 60 percent, minimized fish and wildlife losses, and did not affect any cultural resources. Therefore, Plan 24B was presented as the best plan at the January 1985 workshop. The views and concerns expressed at the workshop by residents in flood prone areas and local officials were considered during the selection of a final plan for flood damage reduction.

During 1985, studies continued to refine Plan 24B for detailed design. Refinements were made in project design to mitigate environmental impacts of the plan. These refinements included increased right-of-way and tree plantings at selected locations. A study was made and a plan was recommended to the local sponsor to mitigate the flood damage impacts on the existing project. Modifications were made in two bridges. A more detailed estimate was made of lands and damages costs. Interest rates and price levels were updated and the flood damage appraisal was refined. These adjustments were judged to have similar impacts on all alternatives and would not affect plan selection. A Draft report was released tentatively outlining Plan 24B as the most favorable plan for reducing damages in the study area and coordination continued with local officials.

In February 1986, additional studies were undertaken to consider a project smaller in scope than Plan 24B. Two additional channel enlargement plans were developed. The plans consisted of variations of Plan 24B to leave out portions of the channel work upstream of Kamper Park and substitute flood plain evacuation to reduce damages in the omitted reaches of stream. The outputs and costs of Plan 24B were compared with the additional plans before the three alternative plans were presented at a public workshop in July 1986. A summary of comparative data relating to the alternative plans is given in Table 3. Annual benefits and costs are based on an interest rate of 8-5/8 percent and October 1985 price levels.

TABLE 3
Upper Gordons Creek Plan Formulation Results
(October 1985 Prices and Development)

PLAN	BENEFITS & COSTS 1/			B/C	DAMAGES 1/			DAMAGES 1/		
	Benefits	Costs	Net Ben		Existing	Remaining	Removed	Existing	Induced	Resulting
	PROPOSED PLAN SEPARATE FROM THE EXISTING PROJECT							EXISTING PROJECT		
24B	1,084.17	739.18	344.99	1.5	1,426.45	342.28	76.0%	72.65	-27.48	100.13
27	1,024.60	614.89	409.71	1.7	1,426.45	401.85	71.8%	72.65	-27.48	100.13
28	879.41	532.24	347.17	1.7	1,426.45	547.04	61.7%	72.65	-27.48	100.13
	PROPOSED PLAN COMBINED WITH THE EXISTING PROJECT 2/									
24B	1,142.41	760.88	381.53	1.5	1,499.10	356.69	76.2%			41.89
27	1,082.84	636.57	446.27	1.7	1,499.10	416.26	72.2%			41.89
28	937.65	553.94	383.71	1.7	1,499.10	561.45	62.5%			41.89

1/ Benefit, Cost, and Damage Values are shown in thousands of dollars.

2/ Includes mitigation of downstream damages so that the resulting damages would be less than the existing damages.

PLAN SELECTION

From the data in Table 3, it was determined that Plan 27 provided the highest net economic benefits. It removes over 72 percent of the average annual flood damages in the basin and has less fish and wildlife losses than Plan 24B. Therefore, Plan 27 is defined as the NED Plan and refined for detailed design leading to a recommendation for implementation.

THE SELECTED PLAN

PLAN DESCRIPTION

The NED plan for flood protection along Upper Gordons Creek in Hattiesburg is channel enlargement extending from Broad Street upstream to Kamper Park and from U.S. Highway 11 upstream to the intersection of South 40th Avenue and Lincoln Road. In the reach from Kamper Park to U.S. Highway 11, nine (9) residences would be evacuated. See Plate 2 for a layout of the plan.

The NED plan consists of an excavated channel with grassed banks on a slope of 1 vertical on 3 horizontal. The channel has a 40 foot bottom width extending 1.1 miles from the end of the existing project at Broad Street to Kamper Park. From Kamper Park to U.S. Highway 11, no channel work would be done. Nine (9) residences on Brooklane Street and South 17th Avenue will be removed from the flood plain. From U.S. Highway 11 to South 28th Avenue, a distance of 1.6 miles, the channel has a 30 foot bottom width. From South 28th Avenue to the end of the project at the intersection of South 40th Avenue and Lincoln Road, a distance of 1.1 miles, the channel has a 20 foot bottom width. The length of all work is 3.8 miles, on 5.0 miles of the stream (mile 2.5 to mile 7.5). A 0.3 mile section of stream in Kamper Park is concrete lined and will not be disturbed. A 0.9 mile section of stream from Kamper Park to U.S. Highway 11 will not be disturbed. Riprap will be provided at 15 bridge crossings and at 22 locations in curves on the channel banks. The alignment and bottom profile of the existing creek will be maintained except at two bridges. Bridges at South 28th Avenue and South 40th Avenue will be replaced and the channel will be straightened in the immediate area of each bridge.

The project includes a right-of-way of 15 feet on each side of the channel for most of the project length. In selected areas the right-of-way is increased to 30 feet to enhance the preservation of wooded areas along the creek. A total of approximately 18 acres would be designated for right-of-way. Additional data on the design of the NED plan is provided in Appendix 2.

Because the NED Plan increases damages along the completed project by $27,480, a mitigation component was added to the plan. An analysis was made of a number of alternative mitigation measures. The least costly, feasible alternative was selected to set the limit of the Federal share of the work. The selected measure consists of flood proofing 21 residences and one business. Federal participation in the mitigation component will consist of a one time cash reimbursement for an appropriate share of the work. Therefore, Federal participation in the mitigation plan selected by the local sponsor will be limited to a percentage of the reasonable cost for flood proofing 21 residences and one business. Details of the evaluation of mitigation measures have been coordinated with local officials and the interested local public. Additional data are presented in Appendix 5.

The percentage of the Federal contribution for mitigation would be the same as the Federal share of the cost of the upstream flood control project. The Federal share is presently estimated to be 45 percent of the total cost of the upstream project; however, the final Federal percentage will be based on the actual cost of the upstream work.

DESIGN AND CONSTRUCTION

About 170,700 cubic yards of material will be excavated for the NED plan. All excavated material will be hauled away from the construction area to a suitable disposal site. Through coordination with local officials, a potential site was identified at the existing city landfill near the downstream end of the project. Approximately nine (9) acres of land will be required for material disposal. Channel excavation will be performed from within the existing channel.

OPERATION AND MAINTENANCE

It would be the responsibility of the local sponsor to operate and maintain all features of the NED plan. An operation and maintenance manual will be developed as a guide and will include adequate measures to prevent significant impairment of the design capacity of the project. Provisions will be made for the protection and maintenance of grassed areas to protect stability of channel banks and disposal areas. Periodic inspection and, if necessary, repairs will be made of the riprapped areas that protect channel banks and bridges. In addition, instream excavation will be required on a periodic basis to remove sediments, debris, and trash from the creek.

PLAN ACCOMPLISHMENTS

The Gordons Creek basin experiences average annual damages of $1,499,100 (October 1985 prices and development) under existing conditions. Upstream work included in the NED plan would reduce damages in the upper basin by $1,024,600 and induce damages of $27,480 along the completed project downstream of Broad Street. Therefore, upstream work removes $997,120 or 67 percent of the damages in the basin. Installation of the mitigation component will provide protection to the level of the 100-year flood for the structures receiving the induced damages. The mitigation component will reduce damages along the existing project by $58,240. Therefore, the NED Plan removes a total of $1,082,840 or 72 percent of the damages in the basin.

Impacts of the plan vary at different locations in the study area. For the portions of stream where channel work will be done, the damages caused by the 5-year flood will be virtually eliminated and damages from the 25-year flood will be significantly reduced. Damages for the 50-year and 100-year flood will be reduced about 67 and 66 percent, respectively. For the reach of stream from Kamper Park upstream to U.S. Highway 11, channel work was eliminated to improve social acceptability. In this area, the with project flood profiles are no more than 0.3 foot higher than before project conditions for all frequencies evaluated. After evacuation of the proposed structures on and near Brooklane Street, the total average annual damages are less than before project conditions. Remaining damages induced by the project in this area are considered to be insignificant.

PROJECT COSTS

The first costs of the NED plan were computed and converted to an average annual basis using a 50-year period of analysis and 8-5/8 percent interest rate which is applicable to all Federal water resource projects currently under investigation. Price levels effective through October 1985 were used in estimating project costs. A contingency factor of 20 percent was used for construction work and lands, but a contingency factor of 25 percent was used for flood proofing measures to mitigate damage on the existing project. Costs for engineering, design, supervision, and administration are based on experience with similar projects. The total project first cost is estimated to be $6,619,000 which does not include the estimated financial cost of resettlement in accordance with PL 91-646, currently estimated to be $270,000. A detailed cost estimate for the NED plan is presented in Table 4.

TABLE 4

Detailed Cost Estimate for NED Plan
(October 1985 Price Levels)

Item	Quantity	Unit	Unit Cost	Total Cost
		STRUCTURAL COMPONENT		
Project Construction				
Channel Enlargement				
Clearing and Grubbing	28.0	Ac	$1,300.00	$36,400
Disposal Area Clearing	4.4	Ac	1,500.00	6,600
Channel Excavation	170,700	CY	5.56	949,100
Riprap	12,830	CY	50.00	641,500
Bedding Material	4,490	CY	40.00	179,600
Filter Cloth	25,770	SY	3.00	77,300
Seeding and Mulching	28.0	Ac	2,300.00	64,400
Drainage Structures (7)		LS		139,900
Contingencies (20%)		LS		419,000
Total Construction Cost				2,513,800
Engineering and Design (8%)				201,400
Supervision and Administration (6%)				150,800
Total for Channel Enlargement				2,866,000
Total Cost for Project Construction				$2,866,000

TABLE 4 (Continued)

Detailed Cost Estimate for NED Plan
(October 1985 Price Levels)

Item	Quantity	Unit	Unit Cost	Total Cost
Lands, Damages, and Relocations				
Lands and Damages				
Land for Right-of-Way	53.8	Ac	$18,680.00	$1,005,000
Severance Damages		LS		393,400
Structures to be Removed		LS		348,500 1/
Land for Disposal Areas	8.8	Ac	2,000.00	17,600
Contingencies (20%)		LS		352,900
Administrative Costs	139	Ea	4,000.00	556,000
Total for Lands and Damages				2,673,400
Relocations				
Bridge Modifications (2)		LS		216,800
Electric Lines		LS		2,200
Pipelines (18)		LS		80,200
Contingencies (20%)		LS		59,800
Total for Relocations				359,000
Total Cost for Lands, Damages, and Relocations				$3,032,400

NONSTRUCTURAL COMPONENT

Item	Quantity	Unit	Unit Cost	Total Cost
Flood Plain Evacuation				
Property Acquisition				
Value of Land and Structures	9	Ea	Varies	$309,600 1/
Contingencies (20%)		LS		61,900
Administrative Costs	9	Ea	$4,000.00	36,000
Total for Property Acquisition				407,500
Demolition and Site Reclamation				
Remove Structures	9	Ea	1,500.00	13,500
Remove Utilities	9	Ea	800.00	7,200
Grade and Grass Site	9	Ea	500.00	4,500
Contingencies (20%)		LS		5,000
Total for Demolition and Site Reclamation				30,200
Salvageable Items	9	Ea	(5,000.00)	(45,000)
Total Cost for Flood Plain Evacuation				$392,700

1/ Does not include Relocation Assistance under PL 91-646.

TABLE 4 (Continued)

Detailed Cost Estimate for NED Plan
(October 1985 Price Levels)

Item	Quantity	Unit	Unit Cost	Total Cost
		MITIGATION COMPONENT		
Habitat Mitigation				
Land for Mitigation	3.7	Ac	$18,680.00	$69,100
Tree Plantings		LS		12,000
Contingencies (20%)		LS		16,200
Total Cost for Habitat Mitigation				$97,300
Mitigation of Induced Flood Damages				
Raising Structures in Place				
Elevating the Structure	21	Ea	$2,100.00	$44,100
Foundation Work	21	Ea	2,000.00	42,000
Landscaping	21	Ea	1,000.00	21,000
Temporary Housing	21	Ea	500.00	10,500
Subtotal for Raising Structures in Place				117,600
Sealing One Structure				
Concrete	133.0	CY	200.00	26,600
Excavation	800	CY	5.50	4,400
Earth Fill	800	CY	6.50	5,200
Interior Drainage		LS		600
Sewer Modifications		LS		500
Landscaping		LS		1,500
Subtotal for Sealing One Structure				38,800
Contingencies (25%)				39,100
Total Construction Cost				195,500
Engineering and Design (10%)				19,500
Supervision and Administration (8%)				15,600
Total Cost for Mitigation of Induced Flood Damages				$230,600 2/
TOTAL COST FOR STRUCTURAL COMPONENT				$5,898,400
TOTAL COST FOR NONSTRUCTURAL COMPONENT				$392,700
TOTAL COST FOR MITIGATION COMPONENT				$327,900
TOTAL PROJECT FIRST COST				$6,619,000

2/ See Appendix 5 for detailed data on mitigation plans.

COST APPORTIONMENT

Prior to 1986, the sharing of costs between Federal and Non-Federal interests for the NED plan was based on the policy established by the 1936 Flood Control Act. However, the traditional policy has been modified to agree with H.R. 6 (Senate) for projects constructed after May 15, 1986. Under the modified policy, non-Federal interests will be required to furnish all lands, easements and rights-of-way, utility relocations and alterations, and all alterations of highway bridges necessary for the purpose of flood damage reduction. Additionally, a cash contribution toward construction, amounting to at least five percent of the total project first cost will be provided by the local sponsor. Non-Federal interests will also be required to operate and maintain the project after construction in accordance with Federal requirements. The Federal Government will be responsible for construction of the channel and the sponsor will be responsible for implementing the evacuation and mitigation measures. Apportionment of costs is shown in Table 5.

TABLE 5
Cost Apportionment

Item	Federal	Non-Federal	Total
Project Construction	$2,554,700	$331,000	
Lands, Damages & Relocations	0	3,032,400	
Flood Plain Evacuation	294,500	78,500	
Subtotal	2,849,200	3,441,900	6,291,100
Percentages	45%	55%	
Habitat Mitigation	44,100	53,200	
Mit. of Induced Damages	104,400	126,200	
TOTAL PROJECT FIRST COST	$2,997,700	$3,621,300	$6,619,000
PL 91-646 Assistance	101,300 1/	168,700 2/	270,000
FINANCIAL PROJECT COSTS	$3,099,000	$3,790,000	$6,889,000

1/ Seventy-five percent of costs associated with evacuation of nine residences ($135,000 x 0.75).

2/ Twenty-five percent of costs associated with evacuation of nine residences ($135,000 x 0.25) and all costs associated with rights-of-way for construction of channel works ($135,000).

INVESTMENT COSTS AND ANNUAL CHARGES

The estimated investment cost and annual charges for the NED plan are shown in Table 6. The total project investment cost (with interest during construction) is estimated to be $7,102,900. The interest during construction is based on a one and one-half year time frame. The estimate of total project annual cost is $636,570, and operation and maintenance is estimated to be $14,000 per year.

TABLE 6

Estimated Investment Cost and Annual Charges
(Oct 85 Prices, 8-5/8% Interest Rate, 50-Year Life)

INVESTMENT COST	
Total Project First Cost	$6,619,000 1/
Interest During Construction	483,900
TOTAL PROJECT INVESTMENT COST	$7,102,900
ANNUAL CHARGES	
Interest	612,630
Amortization	9,940
Operation and Maintenance	14,000
TOTAL PROJECT ANNUAL CHARGES	$636,570

1/ Does not include Relocation Assistance under PL 91-646.

BENEFITS

The primary benefit that would accrue with construction of the NED plan would be the reduction of flood damages. The plan would also provide intangible benefits, such as improved public health, reduced risk to human lives, and less anxiety for people of the area. Although intangible benefits may accrue to the national economy, only tangible, primary benefits are evaluated. A discussion of benefit evaluation is contained in Appendix 1 and a summary is given below:

Flood Damage Reduction	$906,960
Insurable Flood Losses	36,090
Affluence Benefits	65,300
Insurance Overhead Reduction	16,250
Benefits for Mitigation of Induced Damages	58,240
Total	$1,082,840

FEASIBILITY

Project feasibility is determined by dividing benefits by cost to get a number equal to or greater than one. Average annual benefits and costs and B/C are shown below:

Benefits	$1,082,840
Costs	$636,570
Net Benefits	$446,270
B/C	1.7

PHASED CONSTRUCTION

Small projects under Section 205 of the Flood Control Act of 1948 are usually managed as a single construction effort that continues until the project is complete. However, for the NED Plan local costs exceed 3.6 million dollars, and the local sponsor has requested phased construction. Phase 1 would consist of all work downstream of U.S. Highway 11 (Broadway Drive) and Phase 2 would be the rest of the project, all upstream of Highway 11. Phase 2 construction would begin soon (not later than 3 years) after the completion of Phase 1. If construction is managed in phases as defined herein, the costs by project phase are given in Table 7.

Table 7
Detailed Cost Estimate for the NED Plan with Construction by Phases

Item	Phase 1 Quantity	Phase 1 Unit	Phase 1 Unit Cost	Phase 1 Total Cost	Phase 2 Quantity	Phase 2 Unit	Phase 2 Unit Cost	Phase 2 Total Cost	NED PLAN TOTAL COST
STRUCTURAL COMPONENT									
Project Construction									
Channel Enlargement									
Clearing and Grubbing	12.4	Ac	$1,500.00	$18,600	15.6	Ac	$1,140.00	$17,800	$36,400
Disposal Area Clearing	2.0	Ac	1,500.00	3,000	2.4	Ac	1,500.00	3,600	6,600
Channel Excavation	77,500	CY	5.00	387,500	93,200	CY	6.03	561,600	949,100
Riprap	4,130	CY	50.00	206,500	8,700	CY	50.00	435,000	641,500
Bedding Material	1,710	CY	40.00	68,400	2,780	CY	40.00	111,200	179,600
Filter Cloth	9,880	CY	3.00	29,600	15,890	CY	3.00	47,700	77,300
Seeding and Mulching	12.4	Ac	2,300.00	28,500	15.6	Ac	2,300.00	35,900	64,400
Drainage Structures		LS		23,800		LS		116,100	139,900
Contingencies (20%)		LS		153,200		LS		265,800	419,000
Total Construction Cost				919,100				1,594,700	2,513,800
Engineering and Design (8%)				73,600				127,800	201,400
Supervision and Administration (6%)				55,100				95,700	150,800
Total for Channel Enlargement				1,047,800				1,818,200	2,866
Total Cost for Project Construction				$1,047,800				$1,818,200	$2,866,000
Lands, Damages, and Relocations									
Lands and Damages									
Land for Right-of-Way	18.6	Ac	$9,200.00	$171,100	35.2	Ac	$23,690.00	$833,900	$1,005,000
Severance Damages		LS		73,800		LS		319,600	393,400
Structures to be Removed		LS		72,000		LS		276,500	348,500
Land for Disposal Areas	4.0	Ac	2,000.00	8,000	4.8	Ac	2,000.00	9,600	17,600
Contingencies (20%)		LS		65,000		LS		287,900	352,900
Administrative Costs	52	Ea	4,000.00	208,000	87	Ea	4,000.00	348,000	556,000
Total for Lands and Damages				597,900				2,075,500	2,673,400
Relocations									
Bridge Modifications		LS		0		LS		216,800	216,800
Electric Lines		LS		0		LS		2,200	2,200
Pipelines		LS		16,500		LS		63,700	80,200
Contingencies (20%)		LS		3,300		LS		56,500	59,800
Total for Relocations				19,800				339,200	359,000
Total Cost for Lands, Damages, and Relocations				$617,700				$2,414,700	$3,032,400

Table 7 (Continued)
Detailed Cost Estimate for the NED Plan with Construction by Phases

	Phase 1				Phase 2				NED PLAN
Item	Quantity	Unit	Unit Cost	Total Cost	Quantity	Unit	Unit Cost	Total Cost	TOTAL COST
NONSTRUCTURAL COMPONENT									
Flood Plain Evacuation									
Property Acquisition									
Value of Land									
and Structures	9	Ea	Varies	$309,600				$0	$309,600
Contingencies (20%)		LS		61,900				0	61,900
Administrative Costs	9	Ea	$4,000.00	36,000				0	36,000
Total for Property Acquisition				407,500				0	407,500
Demolition and Site Reclamation									
Remove Structures	9	Ea	1,500.00	13,500				0	13,500
Remove Utilities	9	Ea	800.00	7,200				0	7,200
Grade and Grass Site	9	Ea	500.00	4,500				0	4,500
Contingencies (20%)		LS		5,000				0	5,000
Total for Demolition and Site Reclamation				30,200				0	30,200
Salvageable Items	9	Ea	(5,000)	(45,000)				0	(45,000)
Total Cost for Flood Plain Evacuation				$392,700				$0	$392,700
MITIGATION COMPONENT									
Habitat Mitigation									
Land for Mitigation	0.8	Ac	$5,000.00	$4,000	2.9	Ac	$22,450.00	$65,100	$69,100
Tree Plantings		LS		2,000		LS		10,000	12,000
Contingencies (20%)		LS		1,200		LS		15,000	16,200
Ttoal Cost for Habitat Mitigation				$7,200				$90,100	$97,300

Table 7 (Continued)
Detailed Cost Estimate for the NED Plan with Construction by Phases

	Phase 1				Phase 2				NED PLAN
Item	Quantity	Unit	Unit Cost	Total Cost	Quantity	Unit	Unit Cost	Total Cost	TOTAL COST
Mitigation of Induced Flood Damages									
Raising Structures in Place									
Elevating the Structure	21	Ea	$2,100.00	$44,100				$0	$44,100
Foundation Work	21	Ea	2,000.00	42,000				0	42,000
Landscaping	21	Ea	1,000.00	21,000				0	21,000
Temporary Housing	21	Ea	500.00	10,500				0	10,500
Subtotal for Raising Structures in Place				117,600				0	117,600
Sealing One Structure									
Concrete	133.0	CY	200.00	26,600				0	26,600
Excavation	800	CY	5.50	4,400				0	4,400
Earth Fill	800	CY	6.50	5,200				0	5,200
Interior Drainage		LS		600				0	600
Sewer Modifications		LS		500				0	500
Landscaping		LS		1,500				0	1,500
Subtotal for Sealing One Structure				38,800				0	38,800
Contingencies (25%)				39,100				0	39,100
Tttal Construction Cost				195,500				0	195,500
Engineering and Design (10%)				19,500				0	19,500
Supervision and Administration (8%)				15,600				0	15,600
Total Cost for Mitigation of Innduced Flood Damages				$230,600				$0	$230,600
TOTAL COST FOR STRUCTURAL COMPONENT				$1,665,500				$4,232,900	$5,898,400
TOTAL COST FOR NONSTRUCTURAL COMPONENT				$392,700				$0	$392,700
TOTAL COST FOR MITIGATION COMPONENT				$237,800				$90,100	$327,900
TOTAL PROJECT FIRST COST				$2,296,000				$4,323,000	$6,619,000

A test of feasibility for each phase of construction was made and it was found that each would be justified as stand alone increments. It was found that Phase 1 would have a B/C ratio of 2.0 and Phase 2 would be 1.6. That analysis is in Tables 8, 9, and 10. It was also found that Phase 1 would provide 40 percent of the project's effectiveness toward removal of flood damages and Phase 2 would contribute 60 percent.

Table 8
Estimated Investment Cost and Annual Charges for the NED Plan with Construction by Phases

	Phase 1	Phase 2	NED PLAN
INVESTMENT COST			
Total Project First Cost	$2,296,000	$4,323,000	$6,619,000
Interest During Construction	167,900	316,000	483,900
TOTAL PROJECT INVESTMENT COST	$2,463,900	$4,639,000	$7,102,900
ANNUAL CHARGES			
Interest	$212,510	$400,120	$612,630
Amortization	3,450	6,490	9,940
Operation and Maintenance	6,000	8,000	14,000
TOTAL PROJECT ANNUAL CHARGES	$221,960	$414,610	$636,570

Table 9
Breakdown of Benefits for the NED Plan with Construction by Phases

	Phase 1	Phase 2	NED PLAN
Total Flood Damages (Existing Conditions)	$1,499,100	$1,499,100	$1,499,100
Flood Damage Reduction Benefits	314,380	592,580	906,960
Affluence Benefits	22,860	42,440	65,300
Insurance Overhead Reductions	5,690	10,560	16,250
Benefits from Evacuation (Insurable Flood Losses)	36,090	0	36,090
Benefits for Mitigation of Induced Damages	58,240	0	58,240
Total Benefits	$437,260	$645,580	$1,082,840
Percent Damages Removed	29.2%	43.1%	72.2%
Percent of Total Benefits	40.4%	59.6%	100.0%

Table 10
Project Feasibility for the NED Plan with Construction by Phases

	Phase 1	Phase 2	NED PLAN
Benefits	$437,260	$645,580	$1,082,840
Costs	$221,960	$414,610	$636,570
Net Benefits	$215,300	$230,970	$446,270
B/C	2.0	1.6	1.7

LIMITATIONS ON COST APPORTIONMENT

In keeping with the Water Resources Development Act of 1986 (previously H.R. 6) the non-Federal costs should not exceed 50% of total financial project costs. As shown in Table 5, Federal financial costs are $3,099,000 and non-Federal costs are $3,790,000 when apportioned without regard for the 50/50 rule. Included in the non-Federal costs is a cash contribution of $331,000 for project construction. If costs are apportioned as shown in Table 5, the Government would receive from the local sponsor $331,000 at the beginning of construction and then return $345,500 (1/2 of $3,790,000 less $3,099,000) to the local sponsor when the project is completed. A more reasonable alternative for cost apportionment is shown in Table 11.

TABLE 11
Final Cost Apportionment

Item	Federal	Non-Federal	Total
Project Construction	$2,554,700	$331,000	
Lands, Damages & Relocations	359,000	2,673,400	
Flood Plain Evacuation	294,500	78,500	
Habitat Mitigation	0	97,300	
Mit. of Induced Damages	115,300	115,300	
TOTAL PROJECT FIRST COST	$3,323,500	$3,295,500	$6,619,000
PL 91-646 Assistance	101,300	168,700	
Subtotal	3,424,800	3,464,200	
Cost Adjustment	19,700	(19,700)	
FINANCIAL PROJECT COSTS	$3,444,500	$3,444,500	$6,889,000

Table 11 is based on the following assumptions:

1. The local sponsor contributes $331,000 at the beginning of construction;
2. The Government constructs the necessary relocations identified in Appendix 2 of this report at an estimated to cost of $359,000;
3. Cost apportionment for flood plain evacuation and PL 91-646 assistance are defined in Table 5;
4. The local sponsor provides habitat mitigation without cost to the Government;
5. The cost for mitigation of induced damages is shared equally by Federal and non-Federal interests as limited by the cost of the least costly, feasible alternative; and,
6. The government provides the local sponsor $19,700 (1/2 of $3,464,200 less $3,424,800) if necessary after final accounting for project implementation.

ENVIRONMENTAL IMPACTS

An evaluation of the environmental impacts of the NED plan indicated that no significant adverse environmental effects would result from the implementation of the plan. Due to the limited scope of the work and the lack of significant adverse environmental impacts, a determination was made that the preparation of an Environmental Impact Statement (EIS) would not be necessary, and that an Environmental Assessment (EA) would suffice. The EA has been coordinated with appropriate Federal and State agencies. The EA is printed in this report on blue pages ahead of Appendix 1. An evaluation of the environmental effects of the NED plan was made according to the Environmental Protection Agency's 404(b)(1) Guidelines. The Fish and Wildlife Coordination Act report, the Cultural Resources Survey and the 404(b)(1) Evaluation are provided in Appendix 4.

FISH AND WILDLIFE MITIGATION

Throughout the development of a plan to reduce flood damages along Upper Gordons Creek, efforts have been made to incorporate "mitigation" into the project. As defined in the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (NEPA), "mitigation" includes: (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; (e) compensating for the impacts by replacing or providing substitute resources or environments (40 CFR Parts 1500-1508).

Various measures have been incorporated into the NED plan to minimize the loss of 14.0 acres of habitat along a total of 3.8 miles of the stream due to channel enlargement and associated activities. The dimensions of the bottom widths were reduced from 40 to 30 feet between U.S. Highway 11 and South 28th Avenue and between South 28th and South 40th Avenues, respectively. This reduction of bottom width minimizes habitat loss, yet does not sacrifice efficiency of the project in preventing flood damages.

Right-of-way (ROW) along the creek banks would essentially be dedicated for wildlife use since property owners would be prevented from clearing trees or erecting structures within the ROW limits. The standard ROW would be 15 feet along each bank; however, where feasible, the ROW would be increased to 30 feet in certain areas along the creek. The increase amounts to an additional 3.5 acres of ROW and a total of approximately 18 acres would be designated as ROW. Where trees are not present, selected plantings of dogwoods, oaks, or other species valuable to wildlife would be undertaken. The ROW limits would therefore serve as a buffer or green space along Gordons Creek. The costs of additional ROW and tree plantings are identified in the detailed cost estimate. In addition, the bank slopes would be planted with grasses valuable to wildlife, further minimizing habitat losses as well as preventing erosion and associated turbidity.

Other measures to minimize habitat losses which have been incorporated into the NED plan include performing the work within-banks during low flow and the avoidance of construction activities during the fish spawning season. Shoaled areas would be allowed to remain unless deemed an obstruction to flow. In addition, the riprap which is placed at bridge crossings and curves would provide habitat diversity.

PLAN IMPLEMENTATION

INSTITUTIONAL REQUIREMENTS

Submission of this report by the District Engineer will constitute the first step in a series of events which must take place before the project can become a reality. It may be modified at any stage of review, and only if it successfully passes all stages will it ultimately be constructed. These events are:

a. The South Atlantic Division Engineer will provide technical approval of the engineering and design of the recommended plan.

b. The report will be forwarded to the Office of the Chief of Engineers for review of current policy.

c. Funds for advanced planning and design will be allotted.

d. Detailed plans and specifications for the work will be prepared by the Mobile District and submitted to the Division Engineer for approval.

e. Upon approval of the Assistant Secretary of the Army for Civil Works to expend funds for constructing the project, the Chief of Engineers authorizes the project.

f. Contractual agreements will be entered into with the local sponsor and the Secretary of the Army to establish responsibilities for the project.

g. The local sponsor will provide the project lands.

h. The local sponsor will enter into appropriate contractual agreements if needed to conduct their work, including the evacuation of structures and flood proofing.

i. The local sponsor will provide a cash contribution for project construction amounting to at least five percent of the total project first cost.

j. Upon approval of the plans and specifications, construction funds will be provided, the project will be advertised for bids, and a construction contract will be awarded by the Mobile District to the eligible low bidder.

k. Upon completion of construction, an operation and maintenance manual will be prepared by the Mobile District and the project will be transferred to the local sponsor for operation and maintenance.

FEDERAL RESPONSIBILITIES

Federal responsibilities with the NED plan for Upper Gordons Creek are as follows:

a. Construct the project with appropriate cost sharing.

b. Annually inspect the completed project to assure that the project is operated and maintained in accordance with the operation and maintenance manual.

NON-FEDERAL RESPONSIBILITIES

The responsibilities of the local sponsor are as follows:

a. Provide without cost to the United States all lands, easements, and rights-of-way, including mitigative lands for wildlife habitat and suitable borrow and spoil disposal sites necessary for the construction and subsequent maintenance and inspection of the project.

b. Accomplish without cost to the United States all alterations and relocations of buildings, transportation facilities, storm drains, utilities, and other structures and improvements made necessary by the construction, excluding railroad bridges and approaches and excluding the Federal contribution necessary for this project to comply with the non-Federal cost limit in the Water Resources Development Act of 1986.

c. Participate in project construction cost sharing as defined in this report or as modified by the Assistant Secretary of Army (Civil Works).

d. Fulfill the requirements as specified by the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policy Act of 1970 (PL 91-646).

e. Maintain and operate the project after completion without cost to the United States in accordance with regulations prescribed by the Secretary of the Army.

f. Hold and save the United States free from claims for damages which may result from construction and subsequent maintenance of the Project, except damages due to the fault or negligence of the United States or its contractors.

g. Prior to the initiation of project construction, cause the enactment of ordinances and the promulgation of regulations to prevent encroachment on the flood plain storage areas, channels, and

rights-of-way and to prevent an undue increase in the flood damage potential to address the following: (1) Allow no additional development in the 100-year floodway along Gordons Creek which would adversely affect flood flows or would be susceptible to significant damages; (2) Adopt building codes, zoning ordinances, subdivision regulations and other controls as may be necessary to establish minimum floor elevations of structures and other construction criteria for future development in the flood hazard area to prevent future flood damages; and, (3) Maintain eligibility for the National Flood Insurance Program or provide for a program of flood insurance along Gordons Creek within the Project area.

h. At least annually inform affected interests that the channel improvements will not provide complete flood protection.

i. Assume full responsibility for all project costs in excess of the Federal cost limitation of five million ($5,000,000) dollars.

j. Implement an appropriate, plan to mitigate induced damages along the existing project with Federal participation limited to reimbursement of costs not to exceed 50 percent of the feasible plan.

SCHEDULE FOR DESIGN AND CONSTRUCTION

The design and construction efforts for this project are shared between the local sponsor and the Corps of Engineers. A schedule of design and construction has been prepared based on the following assumptions:

a. Construction to be performed in two phases as described;

b. All relocation and modification of utilities to be completed in a given area before the channel work is performed through that area, and;

c. All roadway bridge modification and relocation work to be completed at each bridge site before channel work is carried through or past that site.

d. The local sponsor will begin the evacuation and flood damage mitigation prior to award of a construction contract for channel works.

The design and construction schedule shown in Table 12 delineates the sequencing of both Federal and non-Federal activities necessary for timely completion of the project.

TABLE 12

Design and Construction Schedule

Activity	Initiate	Complete
Local Cooperation Agreement for the Project	1 Oct 86	1 Jan 87
Phase 1		
Mitigation of Damages Downstream of Broad Street	1 Jan 87	1 May 87
Real Estate Acquisition and Evacuation of Structures between Kamper Park and U.S. Highway 11	1 Jan 87	1 May 87
Channel Enlargement, Broad St. to Hardy St.	1 Jan 87	31 Dec 87
Non-Federal Real Estate Acquisition	1 Jan 87	1 May 87
Non-Federal Relocations	1 Jan 87	1 May 87
Plans and Specifications	1 Jan 87	1 May 87
Advertise and Award	1 May 87	1 Jul 87
Construction	1 Jul 87	31 Dec 87
Phase 2		
Channel Enlargement, U.S. Hwy 11 to S. 40th Av.	1 Oct 88	31 Dec 89
Non-Federal Real Estate Acquisition	1 Oct 88	1 May 89
Non-Federal Relocations	1 Oct 88	1 May 89
Plans and Specifications	1 Oct 88	1 May 89
Advertise and Award	1 May 89	1 Jul 89
Construction	1 Jul 89	31 Dec 89

VIEWS OF LOCAL SPONSOR

On July 22, 1986, the Hattiesburg City Council authorized Mayor G. D. Williamson to ask the Pat Harrison Waterway District to act as local sponsor of the project. In a letter dated July 23, 1986, Mayor Williamson made the request, and on July 25, 1986 the Pat Harrison Waterway District confirmed its support for the project. Copies of these three pieces of correspondence are provided in Appendix 5.

SUMMARY OF COORDINATION, PUBLIC VIEWS AND COMMENTS

VIEWS OF NON-FEDERAL INTERESTS

On 28 October 1982, a public meeting was held in Hattiesburg and public workshops were held on 30 January 1985 and 15 July 1986. Copies of the meeting announcements and fact sheets are contained in Appendix 5

At the public workshop on 30 January 1985, local officials and other interested parties reviewed Plan 24B. A favorable reaction was received from property owners in the upper basin and an unfavorable reaction from some residents in the lower part of the basin (along the existing project and in the vicinity of Kamper Park). At the public workshop on 15 July 1986, local officials, and other interested parties reviewed Plan 27, the NED Plan. A favorable reaction was received from property owners along Upper Gordons Creek but some opposition was heard from a few residents along the existing project. Local officials endorsed the project.

REVIEW BY FEDERAL AND STATE AGENCIES

Various Federal and State agencies were notified of the study initiation and public meetings. Coordination and review of the draft report with concerned interests was performed and comments received. The coordination list and resulting comments are contained in Appendix 5.

The U. S. Fish and Wildlife Service (FWS) has been involved in the planning process throughout this study. In accordance with the Letter of Agreement between the Corps of Engineers and the FWS for Fiscal Year 1986, the FWS prepared a Fish and Wildlife Coordination Act Report for the proposed action. A copy of the report is contained in Appendix 4.

CONCLUSIONS

A flood problem was found to exist along Upper Gordons Creek in Hattiesburg, Mississippi and has resulted in damages to residential and commercial development. The most recent flood of significance was in April 1983 and had a frequency of the 100-year flood for most of the stream. However, that flood was estimated to be approaching the 500-year event in one area. The total damages from the storm were estimated to be approximately 14 million dollars. Average annual flood damages along the creek are estimated to be $1,426,450 upstream of the existing project and $1,499,100 for the basin. It is concluded that the most practical plan for reducing flood losses along the creek is the NED plan. A flood warning system for the basin was determined not to be practical at this time.

The NED plan would have a Federal First Cost of $2,997,700 and a Federal Financial Cost of $3,099,000 when PL 91-646 costs are included. It has a benefit-to-cost ratio of 1.7. Average annual damages will be reduced 72 percent and local interests have expressed a desire for the work. Therefore, the Mobile District supports the project which is efficient, effective, complete since plans of others have been considered, and acceptable to local officials if constructed in phases to distribute the financial requirement over a more favorable schedule.

RECOMMENDATIONS

I recommend that the NED Plan for flood damage reduction on Upper Gordons Creek as described in this report be undertaken by the United States under the authority contained in Section 205 of the Flood Control Act of 1948, as amended, at a Federal First Cost presently estimated to be $2,997,700.

This recommendation reflects the information available at this time and current policies governing formulation of individual projects. It does not reflect program and budgeting priorities inherent in the construction nor the perspective of higher review levels. Consequently, the recommendation may be modified before it is approved and funded by the Chief of Engineers.

for Roy A. Prince, LTC
C. Hilton Dunn, Jr.
Colonel, CE
District Engineer

ENVIRONMENTAL ASSESSMENT

ENVIRONMENTAL ASSESSMENT
UPPER GORDONS CREEK FLOOD CONTROL PROJECT
HATTIESBURG, MISSISSIPPI

Need for the Proposed Action

In the last 40 years, four major floods have occurred along Upper Gordons Creek in Hattiesburg, Mississippi. The most recent flood in April 1983 exceeded the 100-year event in most locations and approached the 500-year in the vicinity of Broad Street. Flood damage estimates reached as high as $40 million in Forrest County with a high percentage of this amount being attributed to the expensive residential and business development along Upper Gordons Creek.

Description of the Study Area

Gordons Creek originates from a number of intermittent streams on either side of the Lamar-Forrest County line and flows generally northeast approximately 7.8 miles through the central portion of Hattiesburg before joining the Leaf River. Hattiesburg, which is the county seat of Forrest County, serves as a primary trade center for southern Mississippi and is also a center of educational and governmental activity. The city and county had 1980 populations of 40,889 and 66,018, respectively.

Gordons Creek has a drainage area of about 10 square miles and provides an outlet for approximately 75 percent of Hattiesburg's drainage. A Section 205 project was constructed on the lower 2.5 miles of the creek in 1979 by the Corps of Engineers. This project consisted of clearing and snagging along 1.2 miles and providing an enlarged, unlined 40-foot bottom width channel along 1.3 miles of the creek. The uppermost three-mile reach of the creek traverses newly developed residential subdivisions, commercial properties, and major shopping center complexes. The residential, industrial, commercial, and other developments in the watershed have reduced the natural pervious areas, resulting in an increased amount of storm runoff which enters the creek.

Hattiesburg receives an average of 59.29 inches of precipitation per year. March is the wettest month with an average rainfall of 6.96 inches, whereas October is the driest with an average of 2.53 inches. Nine major floods have occurred in the study area since the beginning of the century; these floods have inundated the flood plain to depths ranging up to approximately 20 feet.

Gordons Creek has not historically experienced significant water quality problems, therefore very little water quality data is available. A short-term intensive water quality study was conducted by the U.S. Geological Society on 16, 17, and 18 October 1973 (sample station: Gordons Creek at the West Pine Street bridge). According to the results of this investigation, relatively high levels of ammonia nitrogen, total phosphorus, and fecal coliform were present at the time of sampling, which is fairly indicative of an urbanized stream. The stream is classified by the Mississippi Bureau of Pollution Control for fish and wildlife use. As would be expected of an urban stream, nonpoint surface runoff contributes coliform bacteria and

nutrients during storm events. The only recognized point source entering Gordons Creek is a car wash near Broad Street; however, numerous drainage pipes empty into the stream at various points within the study area.

The stream within the study area does not support appreciable aquatic life. Most of the fish occurring in Gordons Creek are probably transient adults or juvenile stages which utilize the lower stream reaches, outside of the study area, as a nursery area. The extensive developments in the basin, small volume of dependable base flow, and the general lack of suitable aquatic habitat combine to create a low to nonexistent resident fish fauna, possibly consisting of only Gambusia and shiners, upstream of the Main Street bridge crossing in Hattiesburg.

The plant community existing along the streambanks in the study area in the vicinity downstream of the U.S. Highways 49 and 11 interchange is characteristic of an urban stream, flowing through older established neighborhoods and commercial areas. The area supports scattered large sycamores and pecan trees as well as black willow and sweetgum. Above the Highways 49 and 11 interchange, a small strip of riparian vegetation still persists along the stream despite the extensive residential development. Typical species in this area include water oak and sweetgum.

Because of the reduced quantity and quality of terrestrial vegetation present along Gordons Creek, there is a limited number of wildlife species inhabiting the area. Typical species of amphibians and reptiles that could be found along the creek include southern painted turtle, ground skink, eastern garter snake, and Fowler's toad. Mammals such as gray squirrel, eastern cottontail, opossum, and rodents could also be found in the study area. A variety of songbirds, such as cardinals, brown thrasher, wood thrush, blue jay, and woodpeckers, are fairly common in the riparian vegetation.

The study area is in the reported range of a number of Department of Interior designated endangered and threatened species. Species included on the endangered list are the bald eagle, peregrine falcon, ivory-billed woodpecker, Bachman's warbler, red-cockaded woodpecker, Florida panther, and the American alligator. The yellow-blotched sawback turtle, which may occur near the mouth of Gordons Creek, is presently proposed for inclusion on the endangered list. There is no critical habitat within the study area. Due to the high levels of human disturbance, it is doubtful whether any of the above species occur in the immediate study area.

No archeological or historical sites, properties, or remains were located within the study area during a 10 July 1984 survey by a Mobile District Corps of Engineers' archeologist. A literature and records review showed no properties to be affected by the proposed project. In addition, contact with the Mississippi State Historic Preservation Officer revealed no pending nominations for the National Register, nor any previously recorded archeological sites within the proposed project areas.

Description of Recommended Plan

This plan includes a combination of channel enlargement, evacuation, and bridge modification. Approximately 28.0 acres would be cleared and grubbed

before commencement of channel work. Channel enlargement would involve an approximately 3.8-mile stretch of Gordons Creek between Broad Street and 40th Avenue. Bottom channel widths would vary between 40 feet at the lower end of the project to 20 feet at the upper project limits (refer to Plate 2). The channel would have side slopes of 1 vertical on 3 horizontal and the existing bottom profile of the creek would be maintained. A total of approximately 170,700 cubic yards (cy) of material would be excavated in order to achieve the project dimensions. This excavated material would be disposed of in an approximately 8.8-acre upland section of a 60-acre sanitary landfill owned by the City of Hattiesburg. Placement of approximately 12,830 cy of riprap at curves and bridges, where needed for erosion protection, would also be included.

Evacuation and subsequent removal of several structures next to Gordons Creek would be necessary due to enlargement of the channel. The modification of two highway bridges and the relocation of one electric line and 19 pipelines would also be included. Upon completion of construction activities, the affected areas would be seeded and mulched for erosion protection.

The recommended plan includes measures to mitigate the loss of habitat due to channel enlargement and associated activities. Approximately 18 acres of rights-of-way adjacent to the creek would essentially be dedicated as wildlife habitat in that clearing of trees or the building of structures would be prevented in these areas. Trees such as dogwoods, oaks, or other species valuable to wildlife would also be planted in suitable rights-of-way areas. Other such mitigative elements include performing construction activities during low flow, planting channel slopes with grasses and other vegetation valuable to wildlife, and allowing shoaled areas to remain unless these areas are deemed obvious obstructions to flows.

In addition to the above habitat mitigation measures, measures to mitigate induced flood damages downstream of Broad Street resulting from implementation of the recommended plan are also included. In order to protect the 21 residences and one business from these induced damages, floodproofing measures would be incorporated into the recommended plan. Floodproofing would consist of raising the first floors of the residences between Broad and Green Streets and keeping flood waters away from the Hattiesburg Fitness Center using a flood wall two feet high.

Alternatives to the Recommended Plan

The five alternatives considered in the final array include three channel enlargement plans, flood plain evacuation, and no action. The details of the channel enlargement plans are described in the recommended plan, yet would have different project limits. The limits of the three alternative channel plans are as follows:

(1) Broad Street to 28th Avenue (Broad to Hardy Streets and Camp Street to 28th Avenue, 40-foot bottom width channel).

(2) Broad Street to 40th Avenue (Broad to Hardy Streets and Camp Street to 28th Avenue, 40-foot bottom width; 28th to 40th Avenues, 30-foot bottom width channel).

(3) Broad Street to 40th Avenue and mouth at Camp Street to 34th Avenue on the tributary (same as alternative (2) above with additional work on the tributary: Camp Street to U.S. Highway 49, 30-foot bottom width; U.S. Highway 49 to 34th Avenue; 20-foot bottom width channel).

(5) Broad Street to 40th Avenue (Broad to Hardy Streets, 40-foot bottom width; U.S. Highway 49 to 28th Avenue, 30-foot bottom width; 28th to 40th Avenue, 20-foot bottom width channel).

Flood plain evacuation would involve the removal of 18 structures and associated utilities along the creek within the 10-year flood plain. Once cleared, the area would be graded and grassed. The final alternative, no action, would involve no work being done, either structural or nonstructural, to alleviate the flooding problems.

Environmental Impacts of the Recommended Plan

The most extensive, though not considered to be significant, impacts of the recommended plan would result from channel enlargement and associated activities. Loss of low value habitat would result from the clearing and grubbing of 32.6 acres of streambanks; this area, however, would be seeded with grasses valuable for wildlife and mulched upon completion of channel enlargement activities. The loss of within-bank vegetation would result in reduced shading and, therefore, slightly increased water temperatures. The increase in water temperatures would have no significant effect, as this area is expected to support, at best, limited aquatic resources; only *Gambusia* and shiners are expected to utilize the study area. Riparian habitat, though generally of low quality in the study area, would also be lost due to the clearing and grubbing activities along the streambanks. Along much of the length of the creek, however, trees are present along the area which would become the new creek banks due to implementation of the recommended plan. In areas where trees are presently absent, however, dogwoods, oaks, or other species valuable to wildlife would be planted. Short-term air quality degradation would be expected during clearing and grubbing activities.

Approximately 170,700 cy of material would be excavated in order to achieve the project channel dimensions, resulting in a loss of approximately 14.0 acres along the bank. In order to minimize impacts, all work would be accomplished within-banks. The modification of two highway bridges, the relocation of an electric line and 19 pipelines, and the placement of approximately 12,830 cy of riprap at curves and bridges for erosion protection would also be required due to implementation of the recommended plan. The resulting increase in turbidity would involve only minimal impacts to the fishery in the lower end of Gordons Creek as the work would be performed during low flow, thereby avoiding the spawning season. The excavated material, as well as the debris resulting from clearing and snagging activities, would be placed in an 8.8-acre upland section of a 60-acre sanitary landfill. The landfill, which is owned by the City of Hattiesburg, was also used as the disposal area for the lower Gordons Creek Federal project.

The lands which would be vacated due to the evacuation and subsequent removal of the structures would be landscaped to a more natural condition.

A temporary degradation of air quality would result due to the demolition and removal of these structures. These areas would provide additional natural areas along the creek for birds or other small animals which may utilize the area.

No endangered or threatened species or areas of historical significance would be affected by the implementation of the recommended plan.

Various measures to mitigate for loss of habitat due to channel enlargement and associated activities have been incorporated into the recommended plan. The channel dimensions are essentially mitigative in that bottom widths were reduced from 40 to 30 feet and from 30 to 20 feet between U.S. Highway and 28th Avenue and between 28th and 40th Avenues, respectively. This reduction of bottom width minimizes habitat loss, yet does not sacrifice effectiveness of the project in preventing flood damages.

Rights-of-way (ROW) along the creek banks would essentially be dedicated for wildlife use in that property owners would be prevented from clearing trees or erecting structures within the ROW limits. The standard ROW would be 15 feet along each bank; however, where feasible, the ROW would be increased to 30 feet in some areas along the creek. A total of approximately 18 acres would therefore be designated as ROW. Where trees are not present, selected plantings of dogwoods, oaks, or other species valuable to wildlife would be undertaken. The ROW limits would therefore serve as a buffer or green space along Gordons Creek. In addition, the bank slopes would be planted with grasses valuable to wildlife, further minimizing habitat losses as well as preventing erosion and associated turbidity.

Additional measures of habitat mitigation which have been incorporated into the recommended plan include performing the work within-banks, during low flow, and avoidance of the spawning season. Shoaled areas would be allowed to remain unless deemed obvious obstructions to flow.

Another type of mitigation effort has been incorporated into the recommended plan: mitigation of induced flood damages downstream of the proposed project area. Implementation of the recommended plan would result in additional flood damages between Broad and Green Streets, which are in the existing project area along lower Gordons Creek. In order to reduce this impact on the existing project, floodproofing of 21 residences and one business would be accomplished. Floodproofing of the residences would consist of raising the first floors between 1 and 3 feet, which would provide protection to the elevation of the 100-year flood. The business, the Hattiesburg Fitness Center, would be floodproofed by constructing a flood wall with a height of 2 feet to encompass the structure; this structure would also be protected to the elevation of the 100-year flood. The above floodproofing measures would totally mitigate for the induced damages which would occur downstream of the recommended project.

Environmental Impacts of Other Alternatives

The three channel plans would have impacts similar to that of the recommended plan, yet to varying degrees.

The impacts of the evacuation only alternative would also be similar to the evacuation portion of the recommended plan; however, greater air quality degradation would result due to the removal of 18 rather than 11 structures. The impacts associated with bank clearing and channel modification would be avoided.

The impacts resulting from the implementation of the no action alternative would include continually subjecting the public to the recurring trauma, health, and physical danger associated with flooding. The impacts associated with channel modification and removal of structures would be avoided.

Coordination With Others

A public meeting was held in October 1982 to announce the initiation of the study and to determine the major concerns of the residents along Gordons Creek. Two public workshops were held in Hattiesburg on 30 January 1985 and 15 July 1986, with representatives of the U.S. Fish and Wildlife Service (FWS), as well as State, county, and local agencies in attendance. This document has also been coordinated in the form of letters and/or telephone conversations with the Environmental Protection Agency, the Mississippi Department of Natural Resources, and other interested agencies. See Appendix 5 of the main report for correspondence and other coordination.

The FWS has been involved in the planning process throughout this study. In accordance with the Letter of Agreement between the Corps of Engineers and the FWS for Fiscal Year 1985, the FWS prepared a Fish and Wildlife Coordination Act Report for the proposed action. A copy of the report is contained in Appendix 4. In this report, the FWS made 4 recommendations concerning mitigation of project impacts. These recommendations and the District's responses are as follows:

1. FWS Recommendation. Clearing of vegetation should be limited to the width of the proposed channel. No clearing should be done in the project rights-of-way (ROW).

Corps Response. Clearing would be limited to the top width of the proposed channel. The project ROW would essentially be dedicated as wildlife habitat, thus preventing any future clearing.

2. FWS Recommendation. Where possible, extend width of project ROW to 30 feet in order to total a minimum area of 20 acres.

Corps Response. The project ROW have been increased from the 15 feet standard width to 30 feet in some areas along the creek. A total of approximately 18 acres would therefore be designated as ROW.

3. FWS Recommendation. Unforested portions of the 20 acre ROW should be planted with water, laurel, and willow oaks to benefit urban wildlife.

Corps Response. Where trees are not present, planting of selected species valuable to wildlife would be undertaken.

4. FWS Recommendation. Maintain throughout the project life a protective riparian buffer on the ROW following construction. Prohibit the cutting of trees, with the exception of those which fall into the stream, within this buffer.

Corps Response. Refer to the Corps response to the first FWS recommendation.

Compliance With Federal and State Statutes

The compliance of the recommended plan with Water Resource Council designated environmental statutes is summarized in Table EA-1.

TABLE EA-1

Upper Gordons Creek
Hattiesburg, Mississippi

Compliance of Recommended Plan With
Water Resource Council Designated Environmental Statutes

Federal Statutes

Archeological and Historic Preservation Act.	FC
Clean Air Act, as amended	FC
Clean Water Act, as amended	FC
Coastal Zone Management Act, as amended.............	NA
Endangered Species Act, as amended..................	FC
Estuary Protection Act..............................	NA
Farmland Protection Policy Act......................	FC
Federal Water Project Recreation Act, as amended....	FC
Fish and Wildlife Coordination Act, as amended......	FC
Land and Water Conservation Fund Act, as amended ...	FC
Marine Protection, Research and Sanctuaries Act.....	NA
National Historic Preservation Act, as amended......	FC
National Environmental Policy Act, as amended	FC
Rivers and Harbors Act..............................	FC
Watershed Protection and Flood Prevention Act.......	FC
Wild and Scenic Rivers Act, as amended..............	NA

NOTES: The compliance categories used in this table were assigned based on the following definitions:

FC. Full compliance—All requirements of the statute, E.O., or other policy and related regulations have been met for this stage of planning.

NA. Not applicable—No requirements for the statute, E.O., or other policy and related regulation for this stage of planning.

FINDING OF NO SIGNIFICANT IMPACT (FONSI)
FOR THE RECOMMENDED FLOOD PROTECTION PROJECT ALONG
UPPER GORDONS CREEK, HATTIESBURG, MISSISSIPPI

I. Recommended Plan: The recommended plan includes a combination of channel enlargement, evacuation, and bridge modification. Approximately 32.6 acres would be cleared and grubbed before commencement of channel work. Channel enlargement would involve excavation of approximately 170,700 cubic yards (cy) of material along a 3.8-mile stretch of Gordons Creek between Broad Street and 40th Avenue. Bottom channel widths would vary between 40 feet at the lower end of the project to 20 feet at the upper project limits. The channel would have side slopes of 1 vertical on 3 horizontal and the existing bottom profile of the creek would be maintained. Disposal material would be placed in an 8.8 acre section of a 60-acre sanitary landfill owned by the City of Hattiesburg. Approximately 12,830 cy of riprap would be placed, as needed for erosion protection, along some curves and bridges. Due to channel enlargement, the evacuation and subsequent removal of several structures, the modification of 2 highway bridges, and the relocation of one electric line and 19 pipelines would also be included in the plan.

In order to minimize the habitat losses, approximately 18 acres of right-of-way along the creek would essentially be dedicated as wildlife habitat, in that property owners would be prevented from cutting trees or erecting structures in that area. Where rights-of-way have few or no trees present, trees beneficial to wildlife would be planted. In addition, the side slopes would be seeded and mulched, providing both erosion protection as well as a food source for wildlife utilizing the area. Other habitat mitigation measures which have been incorporated into the recommended plan include performing construction activities within banks, scheduling construction activities during low flow to minimize turbidity, avoidance of the spawning season, and reduction of the channel dimensions as much as possible without reducing hydraulic efficiency.

Implementation of the recommended plan would result in induced flood damages immediately downstream of Broad Street. In order to mitigate for these induced damages, flood proofing measures have been incorporated into the recommended plan. Flood proofing would consist of raising the first floors of 21 residences between Broad and Green Streets and constructing a 2-foot high flood wall around one business. These measures would protect all 22 structures to the elevation of the 100-year flood, thereby resulting in the total mitigation of damages caused by implementation of the recommended plan.

II. Alternatives Considered: Alternatives to the recommended plan included:

a. Broad Street to 28th Avenue (Broad to Hardy Streets and Camp Street to 28th Avenue, 40-foot bottom width channel).

b. Broad Street to 40th Avenue (Broad to Hardy Streets and Camp Street to 28th Avenue, 40-foot bottom width; 28th to 40th Avenues, 30-foot bottom width channel).

c. Broad Street to 40th Avenue and mouth at Camp Street to 34th Avenue on the tributary (same as alternative (2) above with additional work on the tributary: Camp Street to U.S. Highway 49, 30-foot bottom width; U.S. Highway 49 to 34th Avenue, 20-foot bottom width channel).

d. Broad Street to 40th Avenue (Broad to Hardy Streets, 40-foot bottom width; Camp Street to 28th Avenue, 30-foot bottom width; 28th to 40th Avenues, 20-foot bottom width channel).

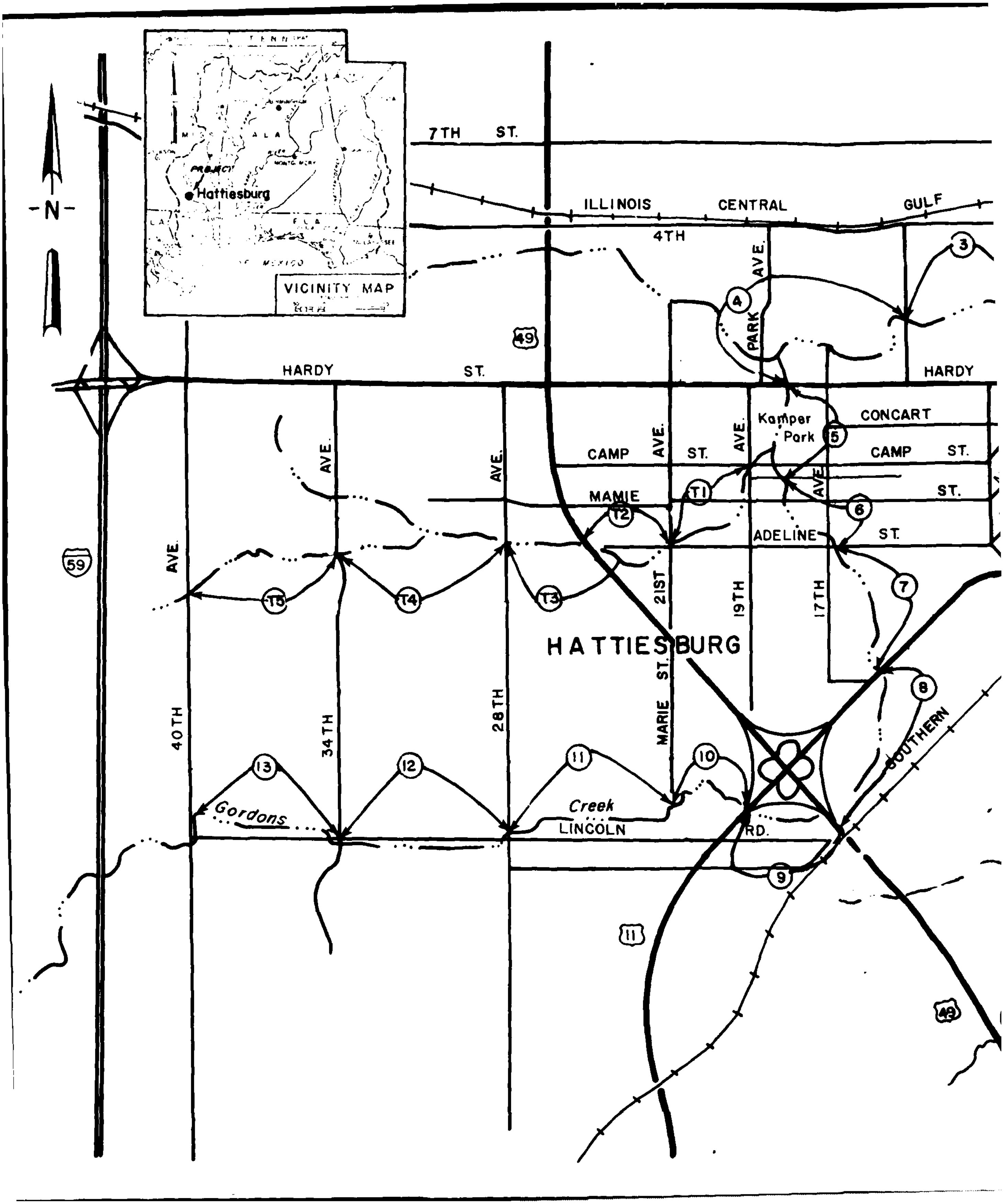
e. Broad Street to 40th Avenue (Broad to Hardy Streets, 40-foot bottom width; U.S. Highway 49 to 28th Avenue, 30-foot bottom width; 28th to 40th Avenues, 20-foot bottom width channel).

III. Factors Considered in the Determination that No Environmental Impact Statement is Required: All impacts which would occur as a result of implementation of the recommended plan have been determined to be insignificant, short-term negative impacts, or beneficial impacts. Adverse impacts include the loss of approximately 14.0 acres of low value bank habitat due to excavation, loss of vegetation growing along the bank slopes, induced flood damages immediately downstream, and increased turbidity during construction. Mitigation measures for both the loss of low value habitat due to widening the channel and induced flood damages downstream of Broad Street have been incorporated into the recommended plan. Beneficial impacts including providing along upper Gordons Creek as well as the protection of the creek banks from further erosion. No endangered or threatened species would be impacted and no cultural resources are known to be in the area. All adverse impacts associated with this action are insignificant and are discussed in the Environmental Assessment.

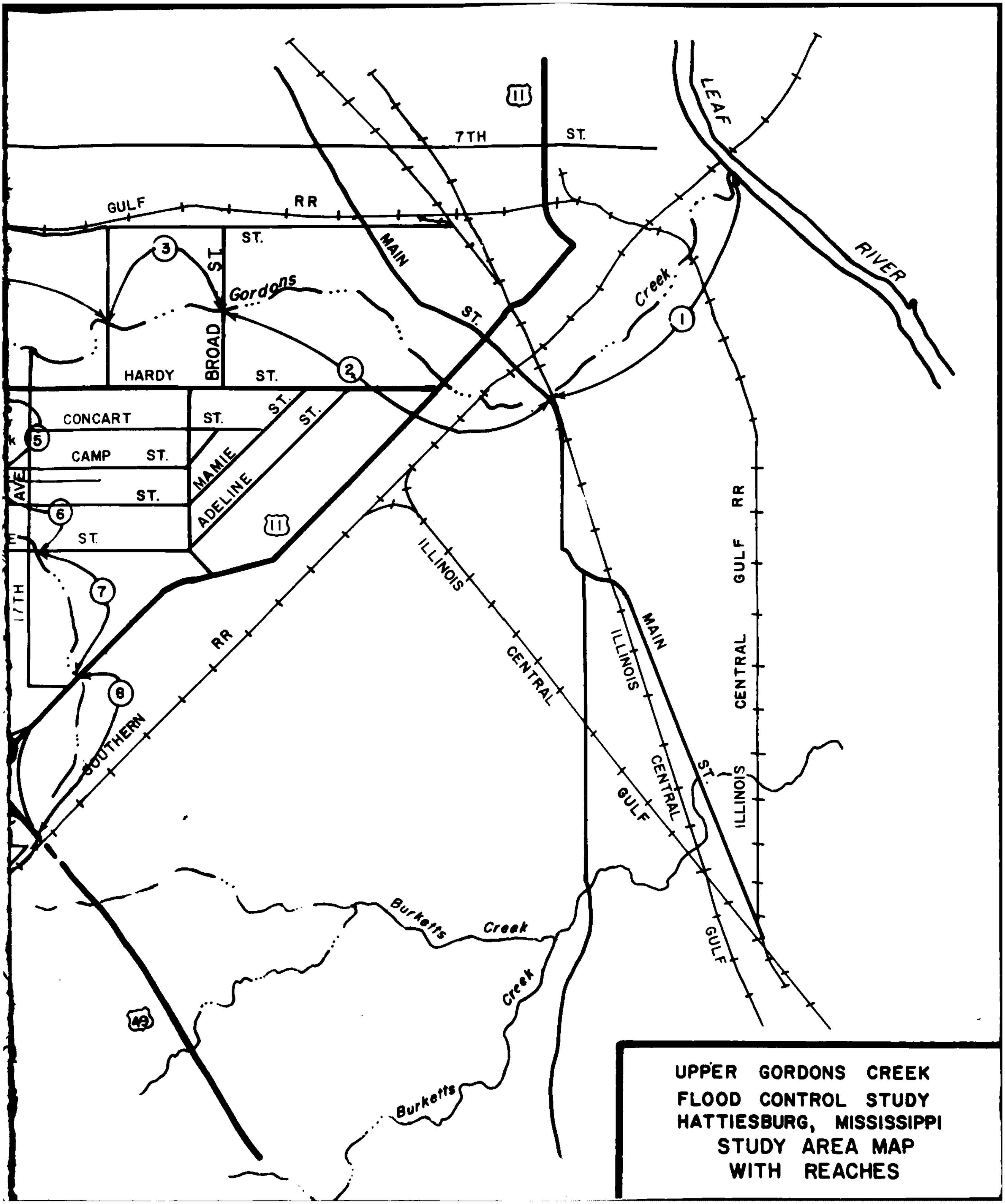
IV. Conclusion: An evaluation of the attached Environmental Assessment describing the proposed action along upper Gordons Creek in Hattiesburg, Mississippi, shows that the recommended plan would have no significant impacts and that an Environmental Impact Statement would not be required.

DATE: 9 Sept 1986

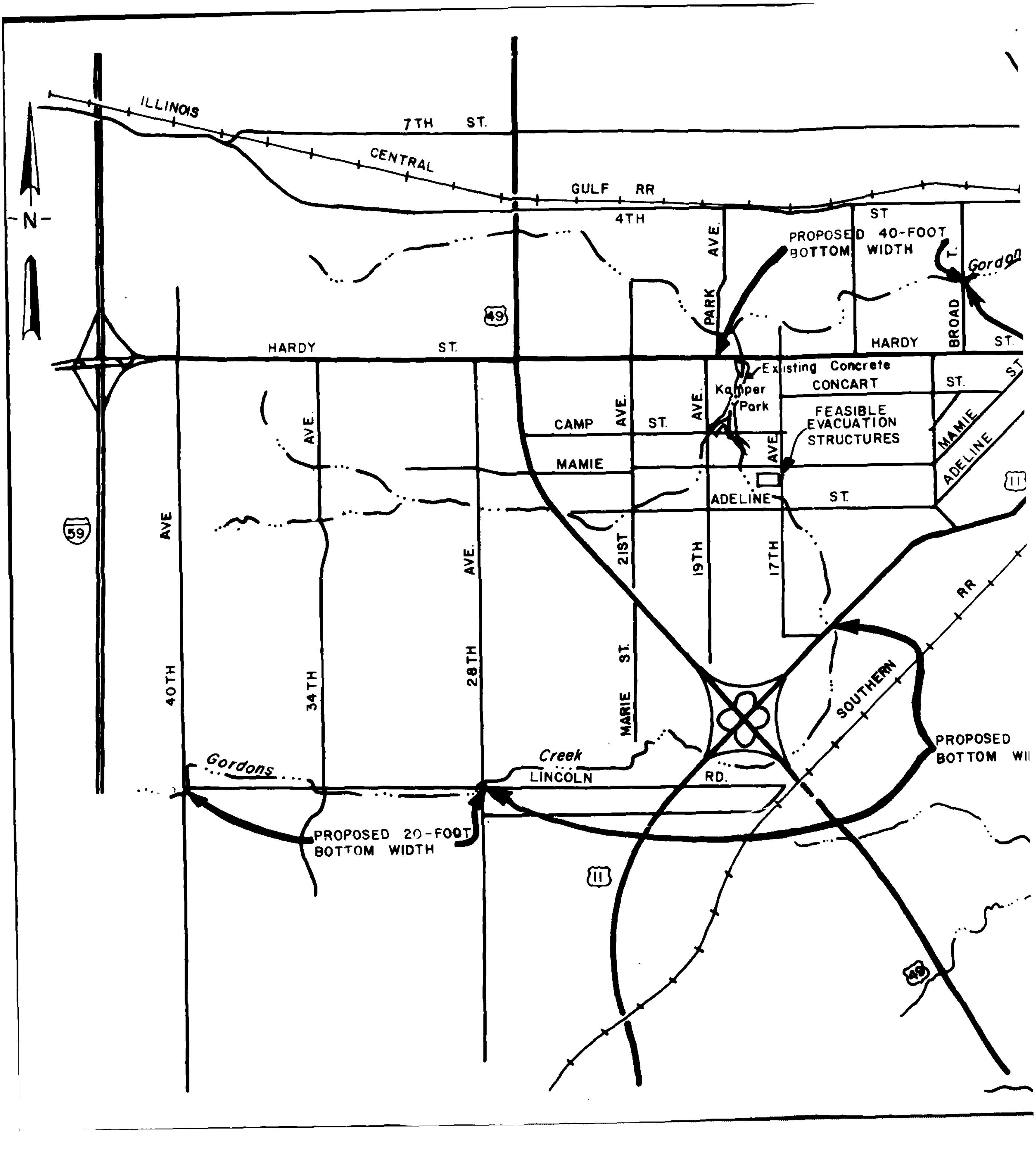
for Roy A. Prince, LTC
C. HILTON DUNN, JR.
Colonel, CE
District Engineer



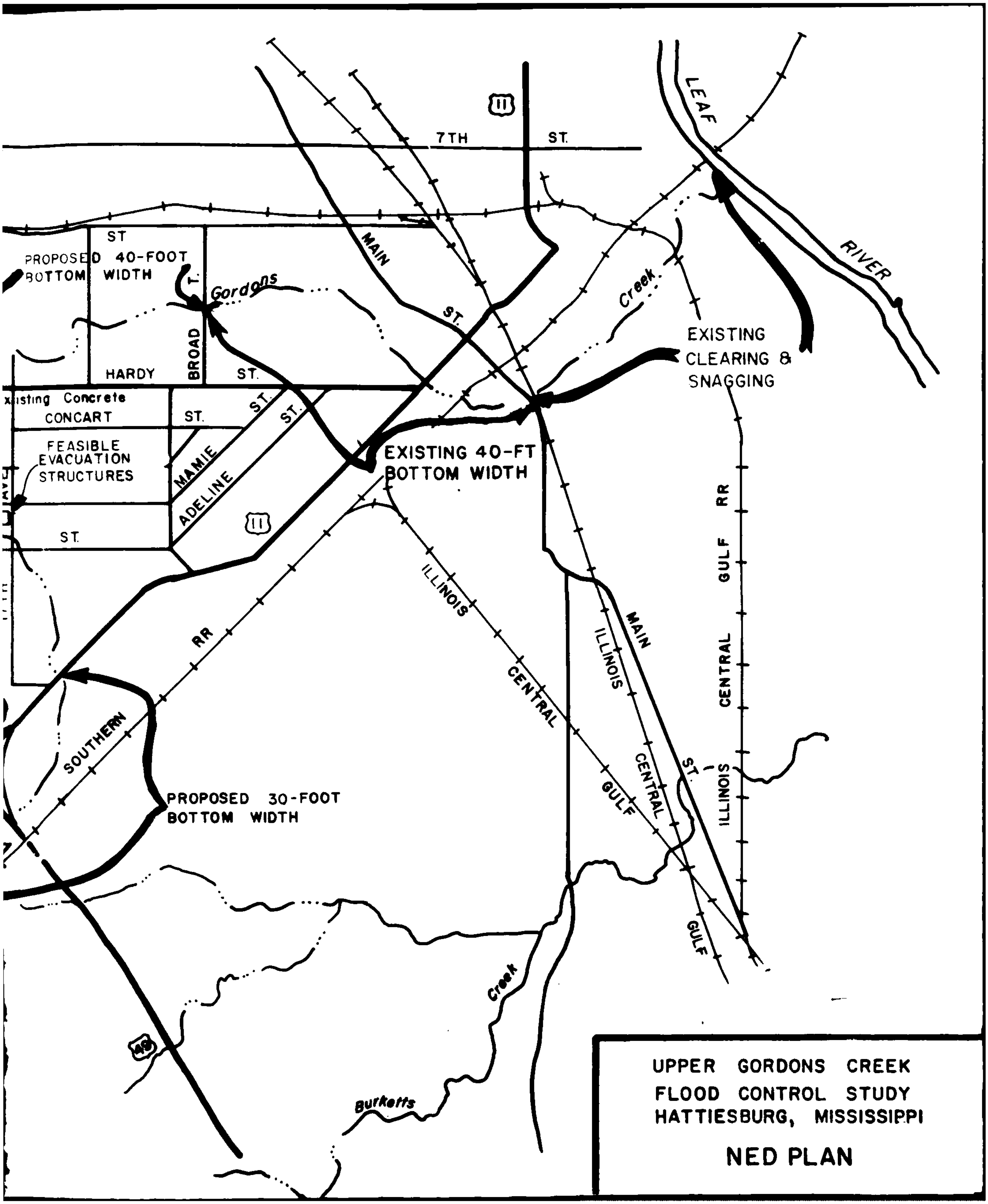
VICINITY MAP
Hattiesburg
PROJECT
N
7TH ST.
ILLINOIS CENTRAL GULF
4TH
PARK AVE.
HARDY ST.
HARDY
Kamper Park
CONCART
CAMP ST.
CAMP ST.
MAMIE
ST.
ADELINE ST.
40TH AVE.
34TH AVE.
28TH AVE.
21ST AVE.
19TH AVE.
17TH AVE.
MARIE ST.
HATTIESBURG
Gordons Creek
LINCOLN RD.
SOUTHERN
59
49
11
1
3
4
5
6
7
8
9
10
11
12
13
T1
T2
T3
T4
T5



UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
STUDY AREA MAP
WITH REACHES



N
ILLINOIS
CENTRAL
GULF RR
7TH ST.
4TH
ST
PARK
AVE.
PROPOSED 40-FOOT
BOTTOM WIDTH
Gordon
BROAD
ST.
HARDY ST.
HARDY
ST
49
Existing Concrete
Kamper
Park
CONCART
ST.
CAMP ST.
AVE.
FEASIBLE
EVACUATION
STRUCTURES
MAMIE
ADELINE
ADELINE ST.
11
59
AVE
40TH
34TH
AVE.
28TH
AVE.
21ST
19TH
17TH
MARIE ST.
RR
SOUTHERN
PROPOSED
BOTTOM WI
Gordons
Creek
LINCOLN RD.
PROPOSED 20-FOOT
BOTTOM WIDTH
11
49



UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI

NED PLAN

APPENDICES

APPENDIX 1

SOCIO-ECONOMIC INVESTIGATIONS

APPENDIX 1

SOCIOECONOMIC INVESTIGATIONS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF CHARTS

SECTION A

INTRODUCTION

This appendix contains an amalgam of sociologic and economic data, as well as assessments and evaluations of the socioeconomic impacts of the various flood damage reduction plans considered for possible implementation in the Gordons Creek study area. The economic evaluations presented in this appendix were performed in a manner which comply with ER 1105-2-40, and fulfill the requirements of the US Water Resources Councils' "Procedures for Evaluation of National Economic Development (NED) Benefits and Costs in Water Resources Planning (Level C)," published as a final rule in the Federal Register on 14 December 1979, and supplemented on 10 March 1983.

This appendix contains four sections: Socioeconomic Profile of the Study Area; Flood Damage Computation for Without Project Conditions; Determination of NED Benefits for Flood Reduction Measures--Initial Stage Planning; and Determination of NED Benefits for Flood Reduction Measures--Final Stage Planning. Subdivision of this appendix resulted in two of the four major sections being devoted to defining the without-project condition of the study area. Section B, titled "Socioeconomic Profile of the Study Area," examines and defines all of the socioeconomic aspects of the study area, with the exception of quantifying flood damage. Section C, titled "Flood Damage Computation for Without Project Conditions," focuses on the parameters crucial to the quantification of average annual equivalent flood damage and is concluded with a presentation of that computation. Sections D and E present the assumptions and methodology used to evaluate plans during the initial and final stages of formulation, and the results of those evaluations. Section E contains a complete analysis of the significant socioeconomic impacts associated with implementation of the selected plan. This section also includes a sensitivity analysis of the benefit computations for the selected plan. The sensitivity analysis derives a range of benefit levels for the selected plan, which could result from reasonable variations in the most probable condition scenario.

SECTION B

SOCIO-ECONOMIC PROFILE OF THE STUDY AREA

GENERAL

Upper Gordons Creek and its tributaries lie within the city limits of Hattiesburg in Forrest County, Mississippi. Prior to the founding of the city in the early 1880's, the area was agriculturally-based, principally in cotton and timber (Watson 1974). In 1884, the City of Hattiesburg was formally incorporated, due largely to the effort of William Harris Hardy who named the new town after his wife, Hattie Hardy. Within a year, Hardy had built a railroad station and could boast that "his town" had 2,000 permanent residents (ibid.) Indeed, Hattiesburg was strategically located at the intersection of rail lines from New Orleans to the northeast and from the eastern Gulf Coast, making it an important shipping and trading center.

One hundred years after its founding, Hattiesburg has a population of over 40,000, encompasses almost 20 square miles and claims a much-diversified economy. For purposes of this analysis, however, the geography of the city must be broken into the discrete units which are most subject to flooding. As the Bureau of the Census is the major source of social, demographic and economic information, such units are census tracts. Wherever possible, therefore, the following discussion will be focused on those urban tracts through which the creek and its tributaries flow as shown in Chart 1-B-1. Some attention will be paid to the total urban area simply to provide the reader with an understanding of the wider human community affected.

DEMOGRAPHY

The flood plain consists of six census tracts with a total population of 19,536 as of 1980. This represents almost 50% of the total recorded for Hattiesburg in the same year. Furthermore, that population had a median age of 31.9 in 1980, significantly older than the 25.5 and 26.5 for the city and the county respectively. An older resident group, living for the most part in family settings and with a fairly high educational level tends to be well-informed and civically active. Table 1-B-1 gives detailed information for the tracts, the city and the county.

TABLE 1-B-1
Upper Gordons Creek Study Area
Population: 1980 1/

ITEM	Population	Median Age	Number of Families
Tract 1	1,273	30.9	266
Tract 2	2,956	36.6	762
Tract 3	3,339	31.9	914
Tract 5	2,614	27.0	583
Tract 7	3,477	34.9	970
Tract 8	5,877	30.3	1,450
Total	19,536	31.9	4,945
City of Hattiesburg (Forrest County only)	39,687	25.5	9,001
Forrest County	66,018	26.5	16,178

1/ Source: Bureau of the Census 1983, PHC80-2-26.

A profile of the city itself is given in Table 1-B-2. It should be noted that while the population rose only slightly between the 1970 and 1980 decennial counts, housing units and general revenues increased substantially. Housing and income are reflective of the health of a local economy. At first glance, then, it would appear that the city enjoys a solid financial base. Closer examination of revenues from property and sales taxes and of employment patterns, listed in Table 1-B-2, indicate otherwise.

TABLE 1-B-2

Hattiesburg, Mississippi
Social Profile 1/

	1970	% Change 1960 to 1970	1980	% Change 1970 to 1980
Land Area Square Mile	18.5		19.2	3.8
Population (Forrest & Lamar Counties)	38,277	9.4	40,829	6.7
Educational Level 4 years of high school or more - % (persons 25 years or older)	58.1		67.2	15.7
Labor Force Total Civilian Workers	14,658		17,476	19.2
Total Employed	14,158		16,648	17.6
Housing Year-round units	12,484		16,003	28.2
Percent in 1-unit Structure	76.0		64.1	-15.7
General Revenue Total in millions of $	5.6		13.5	141.1
Property/Sales Tax Revenue (in millions of $)	2.1 (37.5% of Total)		3.5 (25.9% of Total)	66.7

1/ Source: Bureau of the Census 1978,1984: County and City Data Books, 1977 and 1983

SOCIO-ECONOMIC FACTORS

Income levels in the flood plain vary dramatically. In 1979, they ranged from the medians of $27,000 for Tract 8 residents, living in the southwestern quadrant of the city, down to $6,200 in Tract 1, located in older, downtown Hattiesburg. Families living below poverty were distributed similarly, from less than 5% in Tract 8 to nearly 35% in Tract 1. Table 1-B-3 is a breakdown of relative family wealth for citizens in the flood plain, the city and the county.

TABLE 1-B-3
Upper Gordons Creek Study Area
Income Levels: 1979

	Median Household Income in $	% of Families Below Poverty
Tract 1	6,239	34.6
Tract 2	10,799	15.5
Tract 3	12,857	6.1
Tract 5	7,077	32.5
Tract 7	18,570	5.5
Tract 8	27,035	4.7
City of Hattiesburg (Forrest County only)	10,905	17.7
Forrest County	11,570	16.8

Source: Bureau of the Census, op.cit.

Data presented so far show sharp divisions among the populace living in the flood plain. Such divisions are not only consistent in all categories but also continuous over time, reflecting a deep-rooted disparity. This means that the status of Hattesburg as a university center may be diminished by the differences in education, income, employment and occupation of its citizens. Table 1-B-4 confirms those differences.

TABLE 1-B-4

Upper Gordons Creek Study Area
Employment Patterns: 1980[1/]

	Civilian Labor Force 1979	% Unemployed in 1979	Occupations by Broad Economic Category: Mfg	Trade	Professional
Tract 1	510	30.6	46	100	63
Tract 2	1,491	14.4	116	293	393
Tract 3	1,855	14.1	230	342	524
Tract 5	979	21.9	264	73	232
Tract 7	1,869	14.0	105	406	572
Tract 8	3,091	16.6	228	494	1,055
Total	9,795		989	1,708	2,839
City of Hattiesburg (Forrest County only)	20,686	18.7	2,290	3,130	5,642
Forrest County	33,256	17.1	4,085	5,481	7,954

1/ Source: Bureau of the Census 1983 op.cit.

The manufacturing base in the city of Hattiesburg is relatively diverse, meaning that no one type of industry dominates the local market. Yet the largest employers tend to be those requiring limited skills and paying their workforce less than national average wages. According to listings in the 1983 directory of Mississippi manufacturers, employment by major industrial sectors is: food and kindred products, 699 employees; lumber, wood and paper products, 888; textiles, 521; chemicals and related items, 841; sand, gravel and concrete, 326; metal products, 300; and carbon and electric products 510 workers. The largest manufacturing employers are: Hercules Incorporated with a workforce of 800; Northern Electric Comapny, 500; Marshall Durbin Poultry Company, 425; Big Yank Corporation (men's clothing), 521; Murray Envelope Corporation, 385;and Mississippi Tank Company with 200.

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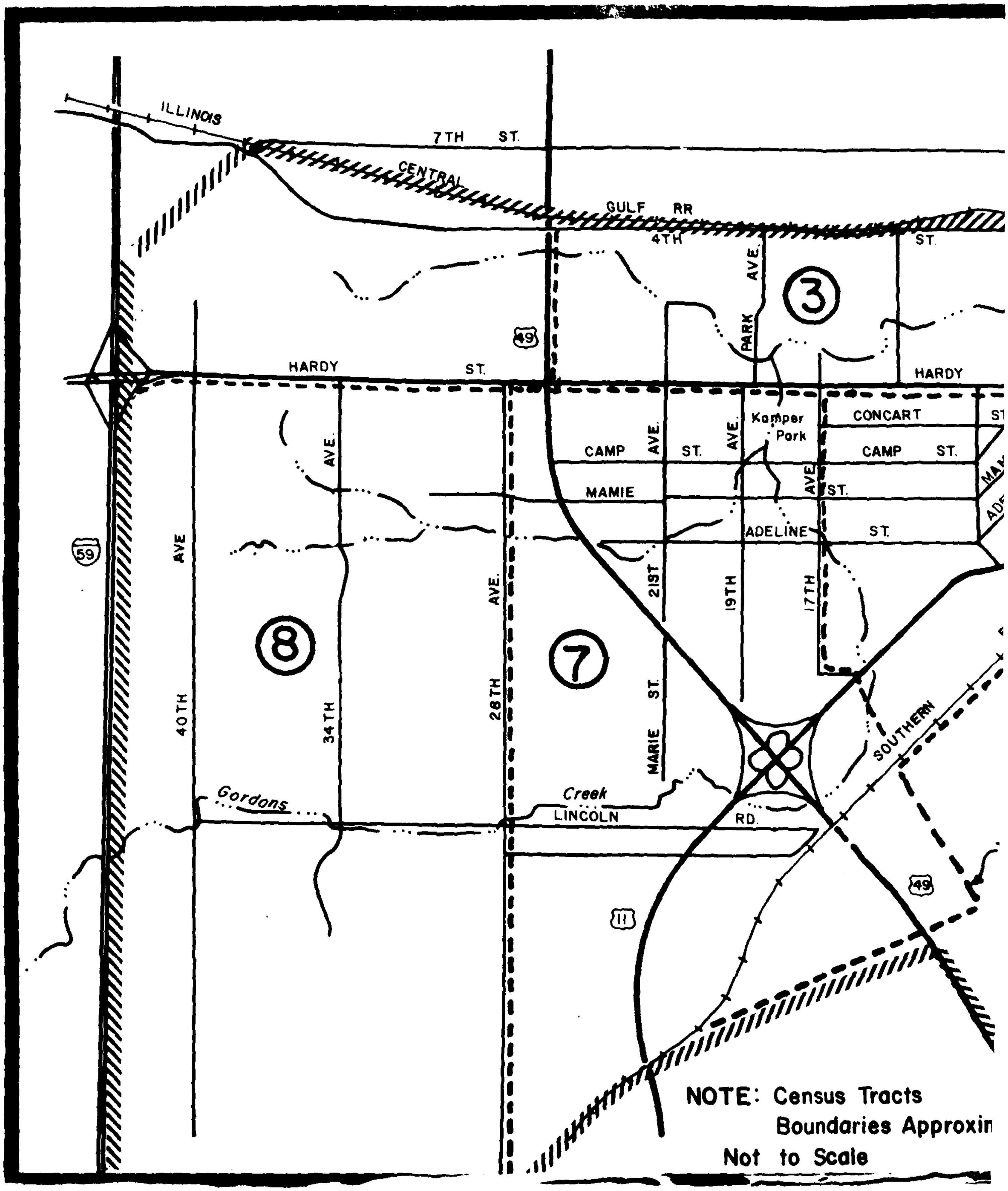
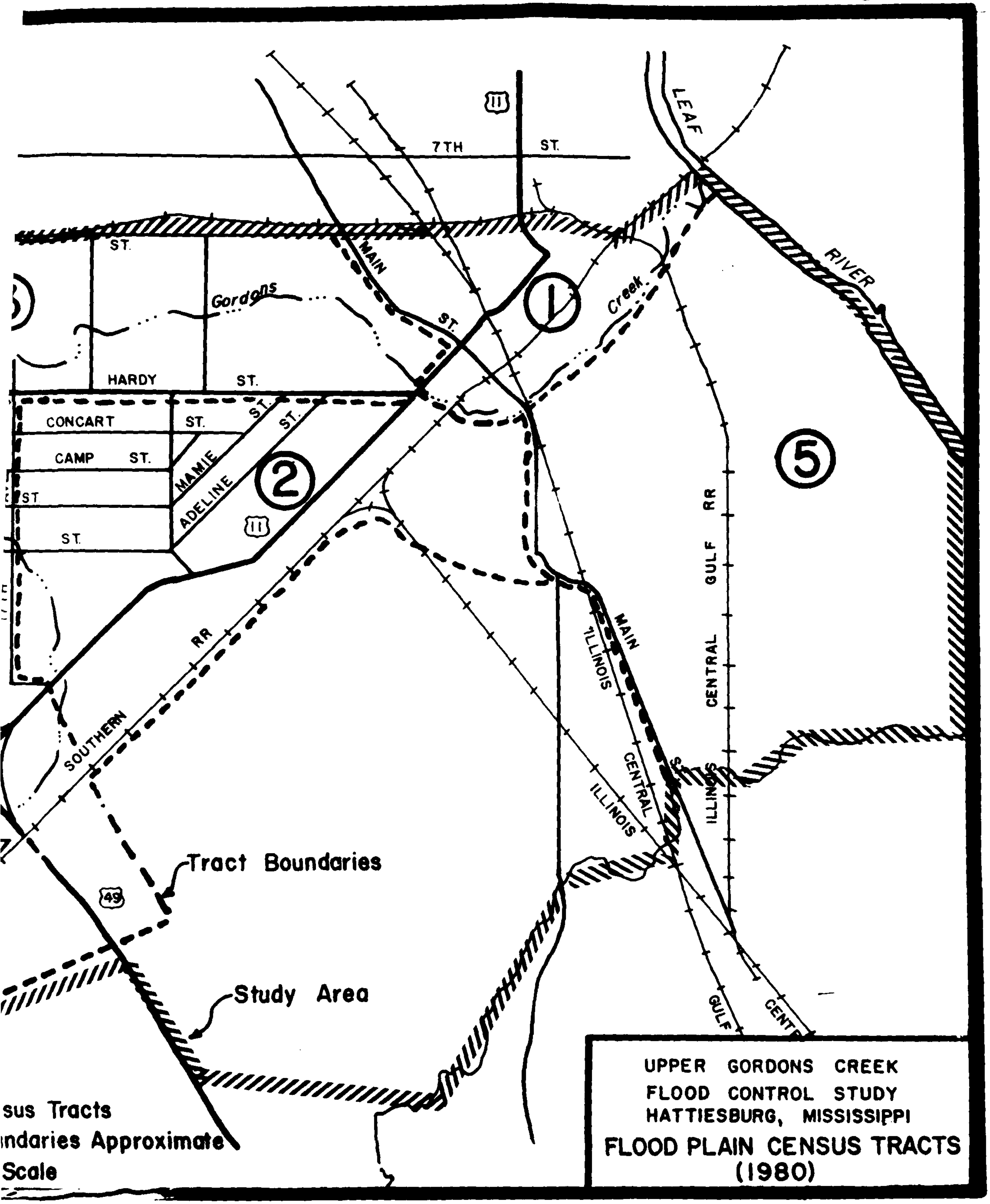
(3) Mississippi Research and Development Center 1983 Mississippi Manufacturers Directory. Jackson, MS: MS Research & Development Center.

(4) Watson, George E. 1974 Historical Hattiesburg. Privately published.


ILLINOIS
CENTRAL
GULF RR
7TH ST.
4TH ST.
PARK AVE.
3
HARDY ST.
HARDY
49
59
CONCART
CAMP AVE. ST.
CAMP ST.
Kamper Park
MAMIE
ST.
ADELINE ST.
40TH AVE
34TH AVE.
28TH AVE.
21ST
19TH
17TH AVE.
MARIE ST.
8
7
Gordons Creek
LINCOLN RD.
SOUTHERN
11
49
NOTE: Census Tracts
Boundaries Approxin
Not to Scale



UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
FLOOD PLAIN CENSUS TRACTS
(1980)

CHART NO. 1-B-1

2

SECTION C

FLOOD DAMAGE COMPUTATION FOR WITHOUT PROJECT CONDITION

GENERAL

The Upper Gordons Creek flood plain has been physically, socially, and demographically described in Section B of this Appendix. This section presents the data, assumptions, and methodology utilized in the computation of average annual equivalent flood damages for the study area conditions which would exist without the implementation of a Federal project. To clearly define the interrelationships between the data and computation results, presentations are made in verbal, tabular, graphical, and pictorial form. This section is divided in seven major headings as follows:

Assumptions
Data Collection
Subdividing the Flood Plain
Land Use within the Flood Plain
Flood Plain Housing
Inventory of Flood Plain Development
Average Annual Equivalent Flood Damage

These headings are presented in the approximate chronological order in which the activity they describe was performed, and portray the logical sequential methodology applied to the task of arriving at a quantification of average annual equivalent flood damage for the Upper Gordons Creek SPF flood plain.

ASSUMPTIONS

As basis for the evaluation of urban flood damage in the study area, some basic assumptions regarding the economics of the flood plain must be made.

Stemming from the analyses presented in Section B, and established procedure utilized by the Corps of Engineers in flood control planning, the following assumptions formed the basis for further analyses of the flood hazard:

a. Flood plain residents will react to a flood plain management plan in a rational manner.

b. Real property will continue to be repaired to preflood conditions subsequent to each flood event.

c. No new residential development in the flood plain is anticipated during the period of analysis (from existing to 2037 conditions), since the City of Hattiesburg has no Comprehensive Development Plan.

d. The value of contents of single and multi-family residential structures is assumed to equal 50 percent of the value of the structures (vc/vs ratio = .50), which is based upon industry standards.

e. Multi-family residential structure depth-damage relationships were assumed to be similar to single story residential depth-damage relationships.

f. Data used to make growth projections were obtained from BEA.

g. Growth projections are based on long run or secular trends and do not respond to the short-term dynamics of the economy.

h. The assumptions contained within the BEA projections are considered appropriate for the purposes of this study.

i. The value of residential contents will rise over the study period in direct relationship to the growth in per capita income as computed for the study area from BEA data.

j. The upper limit of the increase in the value of residential contents is 75 percent of the structure value (in accordance with WRC Procedures Manual).

k. Growth rates of content value computed for single family units were also applied to the content values for multi-family units.

l. The Federal Flood Insurance Administration's 1970 percent damage vs depth relationships for residential property were considered appropriate for the types and values of properties located in the Hattiesburg flood plain.

m. The FIA 1970 percent depth vs damage relationships for residential property will remain accurate and applicable for the 1987-2037 analysis period.

n. Commercial and industrial depth damage relationships based on field interviews and past flood surveys, verified by <u>Means Building Construction Cost Data</u>, 1977, as updated by the use of ENR Index Numbers, are appropriate for use in this study.

o. The remaining physical life of all structure in the flood plain is 50 years.

p. Fair market value appraisals of properties and lands in the flood plain included the effects of all market conditions, including the effects of recognition of the flood hazard.

q. The selection of a base year of 1987, from which projections for the 50-year analysis period are based, allows for the expected time required for authorization, funding, and construction/implementation of a Federal project.

DATA COLLECTION

Collection of data to be utilized in the analyses of the economics of the Upper Gordons Creek Flood Plain was performed by Corps of Engineers Mobile District Office personnel.

Structure value of all properties (residential, commercial, etc.) in the flood plain were compiled through field survey by Corps staff appraisers. Inventory and equipment valuations of all non-residential properties were complied through field survey by Corps planning researchers.

Corps planning researchers compiled, through third order field survey, the remaining data for economic analysis of the flood plain:

a. Spatial location and identification (name/address) of each property;
b. Ground and first-floor elevation of each property.

SUBDIVIDING THE FLOOD PLAIN

To facilitate an orderly presentation of data, control errors, and provide for the easy manipulation of data, the Hattiesburg flood plain was divided into segments termed "major reaches." The "major reaches" were further subdivided into segments termed "subreaches." Later discussions and computations appearing in this appendix will refer to this breakdown of the flood plain, and relate various flood hazard parameters to each major reach or subreach when appropriate. These more manageable subdivisions will also aid in the formulation of various components of possible flood control plans.

It should be noted that the lower portion of Gordons Creek (mouth to Broad Street) has been excluded from this section of this Appendix (this lower portion is shown on Chart 1-C-1 as reaches 1 and 2). The lower portion of Gordons Creek will be discussed upon selection of the plan which will reduce flood damages along Upper Gordons Creek.

Methodology for Subdivision. In considering where to divide the Upper Gordons Creek flood plain, many factors were weighed. The existing flood plain characteristics were considered, as well as any dynamic factors, which may act to alter land use or flood characteristics in the future. The four general factors evaluated were as follows: The spatial distribution of the various types of land use and density of land use in the flood plain; points of significant change in either hydrologic or hydraulic characteristics of the flood plain; locations of areas of particularly high hazard, either due to depth of flooding or high velocities; and areas of possible variation in land use in the future. Eleven (11) major reaches on the main stem and five (5) on the tributary were established for the aggregation and presentation of flood damages and 45 subreaches were developed within these sixteen (16) major reaches to provide accuracy in flood damage computation.

Description of Major Reaches. Chart 1-C-1 illustrates the Upper Gordons Creek Standard Project Flood Plain (SPF), and the location of the limits of the 16 major reaches utilized during this study. Table 1-C-1 describes the physical limits and development aspects of each of these major reaches.

TABLE 1-C-1
Upper Gordons Creek
Descriptions of Major Reaches

MAIN STEM	PHYSICAL LIMITS (STREETS WITHIN SPF BOUNDARIES)	LAND USAGE
Reach 3	Broad to Lurty	Lt Residential and Lt Public
4	Lurty to Hardy	Lt Residential and Lt Commercial
5	Hardy to Eva	Lt Public and Lt Commercial
6	Eva to Adeline	Lt Residential and Lt Commercial
7	Adeline to Hwy 11	Lt Residential and Lt Commercial
8	Hwy 11 to Hwy 49	Lt Commercial
9	Hwy 49 to Lincoln	Lt Residential and Lt Commercial
10	Lincoln to Marie	Lt Residential and Lt Commercial
11	Marie to 28th	Lt Residential and Lt Commercial
12	28th to 34th	Lt/Hv Residential & Lt Commercial
13	34th to Hwy 59	Lt Residential and Lt Commercial
TRIBUTARY		
Reach 1	Camp/Eva to 21st	Lt Residential
2	21st to Hwy 49	Lt Residential and Lt Commercial
3	Hwy 49 to 28th	Lt Residential and Hv Public
4	38th to 34th	Lt Residential and Hv Commercial
5	34th to 40th	Lt Residential

Legend: "Lt" = Light "Hv" = Heavy

Subreaches. To improve accuracy in the determination of flood damages from differing flood stages upon various spatial distributions of development, the sixteen (16) major reaches were further subdivided into "subreaches". Significant changes in the SPF water surface and physical cross-section delineation from the HEC Hydraulic Model coupled with spatial urbanization patterns were the basis for forming this more extensive breakdown. This fine tuning of the flood damage model produced a more sensitive model which more closely evaluated the changes in water surface and, thus flood damage reduced by the many alternative flood control plans evaluated. As a means to identify each subreach, a nomenclature was developed which contained two elements each having a specific meaning. The first element is a numeric character which indicated the major reach in which the subreach lies. The second element is

an alpha character which distinguishes the subreach from other subreaches in the same major reach (example 3-A). This designation would indicate a subreach in major Reach 3 and having the identifier of A. Chart 1-C-1 illustrates the Upper Gordons Creek Standard Project Flood Plain and its subdivision into 45 subreaches, of which 41 subreaches contained damageable property. The tributary begins at Reach 6 of the main stem of the creek and is segmented into reaches and subreaches as indicated above, with a "T" prefix.

LAND USE WITHIN THE FLOOD PLAIN

Acreages by land use category for this flood plain are shown in Table 1-C-2. The total land area of the SPF flood plain is 202.14 acres. Nearly all of the flood plain (98 percent) lies in Forrest County and within the incorporated area of Hattiesburg; Lamar County contains the headwaters of the main tributary, or two (2) percent of the flood plain. Most of the flood plain is fully developed; however, 26.05 acres are available for development with half of the undeveloped acreage being in the headwaters (Reach 13 of the main stem).

Residential property is the largest user of the flood plain with 59 percent of the total acres available and 67 percent of the developed acres. Commercial property is the second largest user, occupying 19 and 22 percents of the total available and developed acreage, respectively. Public/Semi-Public usage accounts for 10 and 11 percents, respectively, of these same totals.

TABLE 1-C-2
Upper Gordons Creek SPF Flood Plain
Existing Land Use (1983) By Reach
(Acres)

REACH	COMMERCIAL	PUBLIC SEMI-PUBLIC	RESIDENTIAL	UNDEVELOPED (Open)	TOTAL
MAIN STEM					
3	1.06	7.35	9.01	0.00	17.42
4	2.28	0.00	15.45	0.00	17.73
5	1.26	8.76	2.05	0.00	12.07
6	0.00	0.00	6.87	0.00	6.87
7	2.60	0.00	8.38	0.00	10.98
8	19.24	0.00	0.00	0.00	19.24
9	1.50	0.00	8.05	3.21	12.76
10	3.49	0.00	0.20	4.34	8.03
11	2.10	0.50	14.53	5.38	22.51
12	0.84	0.00	18.67	0.00	19.51
13	0.00	0.82	8.90	13.12 1/	22.84
Sub-Total	34.37	17.43	92.11	26.05	169.96
TRIBUTARY					
1	0.00	0.00	7.80	0.00	7.80
2	0.25	0.00	4.69	0.00	4.94
3	0.00	2.00	5.02	0.00	7.02
4	3.30	0.00	6.70	0.00	10.00
5	0.00	0.00	2.42	0.00	2.42
Sub-Total	3.55	2.00	26.63	0.00	32.18
TOTAL	37.92	19.43	118.74	26.05	202.14
Percent of Total	19%	10%	59%	13%	100%
Percent of Development	22%	11%	67%	--	--

1/ Includes 4.34 undeveloped acres in Lamar County. The remainder, 197.80 acres are within Forrest County.

FLOOD PLAIN HOUSING

Table 1-C-3, "SPF Flood Plain Inventory-Residential Property", describes the value, age, and condition of the residential property in this flood plain. Generally, reaches 11, 12, and 13 on the main stem and reaches 3, 4, and 5 of the tributary contain housing in good to excellent condition, or 48% of the flood plain residences. The remainder of the flood plain (except the 16 residences in reach 9 of the main stem) contains structurally sound residences which are in good condition.

Apartments are located in four reaches of the Upper Gordons Creek flood plain and are of the following quality:

Main Stem		# First-Floor Apts.	Condition
Reach 4	-	12	Good
Reach 5	-	6	Good
Reach 6	-	13	Good
Reach 12	-	68	Excellent
TOTAL		99	

INVENTORY OF FLOOD PLAIN DEVELOPMENT

General. Under the previous discussion of land use in the study area, tables were displayed indicating the spatial distribution of various land areas serving various categories of use throughout the standard project flood plain. Three basic categories were defined in that discussion and will be utilized again in the following paragraphs to detail the type and value of development in the 16 major reaches of the flood plain.

TABLE 1-C-3

UPPER GORDONS CREEK

SPF FLOOD PLAIN INVENTORY - RESIDENTIAL PROPERTY

($1,000)

REACH	NUMBER OF STRUCTURES	AVERAGE STRUCTURE VALUE	TOTAL VALUE OF STRUCTURES	TOTAL VALUE OF CONTENTS	ESTIMATED AVERAGE AGE OF STRUCTURES	ESTIMATED CONDITION 2/
Main Stem						
3	69	$29.4	$ 2,028.6	$ 1,014.3	30	Average
4	177	32.7	5,783.2	2,891.6	20	Average - Good
5	33	29.8	984.2	492.1	25	Average - Good
6	98	28.6	2,806.0	1,403.0	20	Average - Good
7	71	33.1	2,349.8	1,174.9	25	Average - Good
8	0	0	0	0	--	-
9	16	9.5	152.0	76.0	25	Poor - Fair
10	0	0	0	0	--	-
11	114	50.7	5,782.1	2,891.0	15	Very Good
12	189 1/	47.7 1/	9,024.3	4,512.2	7	Very Good
13	38	77.6	2,950.0	1,475.0	5	Excellent
SUB-TOTAL	805	$39.6	$31,860.2	$15,930.1		
Tributary						
1	73	34.5	2,517.4	1,258.7	20	Average - Good
2	37	35.8	1,324.6	662.3	25	Average - Good
3	22	59.3	1,304.6	652.3	18	Good
4	43	59.3	2,549.9	1,275.0	15	Very Good
5	26	59.3	1,541.8	770.9	8	Very Good
SUB-TOTAL	201	$46.0	$ 9,238.3	$ 4,619.2		
TOTAL	1,006 3/	$40.9	$41,098.5	$20,549.3		

1/ Includes 68 bottom-story apartments valued at $15.0 each. Excluding these apartments, the average value of each residence would be $66.2 in Reach 12.

2/ Based upon a combination of age, construction, and care (see Residential Cost Handbook, 1982, Marshall and Swift Publication Co., Los Angeles, CA).

3/ Nin -nine structures are bottom-story apartments.

Development Inventory. Shown in Tables 1-C-3 and 1-C-4 are data which illustrate the spatial distribution and the value of flood plain development in the major reaches for residential, commercial, and public categories.

There are unique features of each of these development categories which should be pointed out:

Residential. Approximately 61 percent of the structures within the Upper Gordons Creek SPF flood plain are built on piers. The height of the piers is not uniform and this results in inconsistencies in the areal distribution of flood damage. The average age of residential structures decreases with distance from the downtown core of Hattiesburg. The general condition of residential structures tend to increase as the stream meanders westwardly from the downtown core. Table 1-C-3 makes comparisons of structure ages, fair market value, and their locations in the flood plain.

Commercial. Most of these structures are constructed on slabs and are concentrated along main transportation arteries, with the remainder scattered throughout the flood plain. Table 1-C-4 displays the distribution of commercial structures and values in the flood plain.

Public/Semi-public. Public and semi-public structures are dispersed rather evenly throughout the flood plain. This dispersion is a result of the nature of their purpose: to serve various users in certain areas of each urban center. Table 1-C-4 displays data on the institutional structures.

TABLE 1-C-4

UPPER GORDONS CREEK

SPF FLOOD PLAIN INVENTORY - OTHER PROPERTY

($1,000)

REACH	COMMERCIAL # STRUCTURES	COMMERCIAL STRUCTURE VALUE	COMMERCIAL INVENTORY & EQUIPMENT	PUBLIC # STRUCTURES	PUBLIC STRUCTURE VALUE	PUBLIC INVENTORY & EQUIPMENT	OTHER[1/] # STRUCTURES	OTHER[1/] STRUCTURE VALUE	OTHER[1/] INVENTORY & EQUIPMENT
Main Stem									
3	1	$ 600.0	$ 210.0	10	$3,716.2	$1,012.6	0		
4	22	2,029.7	1,892.2	3	232.0	113.0	1	$ 52.5	$ 31.0
5	1	162.9	25.1	8	203.6	61.6	0		
6	0			0			0		
7	18	4,008.2	3,946.2	0			1	145.2	175.0
8	31	8,868.8	5,953.8	1	70.0	0.2	1	22.1	25.0
9	4	523.3	530.0	1	31.2	12.0	0		
10	2	467.6	100.0	1	273.0	275.0	1	140.0	0.2
11	14	521.1	499.4	2	1,226.0	180.0	1	45.0	0.2
12	6	1,696.6	1,770.0	0			0		
13	0			3	638.0	232.0	0		
SUB-TOTAL	99	$18,878.2	$14,926.7	29	$6,390.0	$1,886.4	5	$404.8	$231.4
Tributary									
1	0			0			0		
2	1	50.0	40.0	0			0		
3	0			0			0		
4	14	5,572.6	3,416.0	0			0		
5	0			0			0		
SUB-TOTAL	15	$ 5,622.6	$ 3,456.0	0	0	0	0	0	0
TOTAL	114	$24,500.8	$18,382.7	29	$6,390.0	$1,886.4	5	$404.8	$231.4

1/ Marine, transportation or communications/utilities company (should be considered as "commercial").

Flood Plain Development Summary. Table 1-C-5 displays a composite inventory of the development categories in this flood plain. The total development is valued at 113 million dollars, excluding lot/land investments. Residential structures and contents account for 54 percent of the total flood plain capital value. Commercial and public properties represent 39 and 7 percents respectively of the capital value of the flood plain.

Analysis of the data presented in Table 1-C-5 on a reach basis further heightens the perception of the distribution of damageable development. Residential development is almost evenly distributed along the stream, except in Reaches 8 and 10 of the main stem. Commercial development is heaviest in Reaches 7 and 8 of the main stem and Reach 4 of the tributary. No public/semi-public property occupies the flood plain of the tributary (all medical facilities in Reach 4 of the tributary were treated as "commercial" property).

In general, eighty (80) percent of the damageable property in the total flood plain is located on the main stem, and twenty (20) percent is located on the tributary.

TABLE 1-C-5

COMPOSITE DEVELOPMENT INVENTORY

UPPER GORDONS CREEK

($1,000)

REACH	RESIDENTIAL NUMBER STRUCTURES	RESIDENTIAL STRUCTURE/ CONTENTS	COMMERCIAL NUMBER STRUCTURES	COMMERCIAL STRUCTURE/ INVENT./EQUIPMENT	PUBLIC/SEMI-PUBLIC NUMBER STRUCTURES	PUBLIC/SEMI-PUBLIC STRUCTURE/ INVENT./EQUIPMENT	TOTAL NUMBER STRUCTURES	TOTAL TOTAL VALUE	PERCENT OF TOTAL VALUE
Main Stem									
3	69	$ 3,042.9	1	$ 810.0	10	$ 4,728.8	80	$ 8,581.7	7.5
4	177	8,674.8	23	4,005.4	3	345.0	203	13,025.2	11.5
5	33	1,476.3	1	188.0	8	265.2	42	1,929.5	1.7
6	98	4,209.0	0	0	0	0	98	4,209.0	3.7
7	71	3,524.7	19	8,274.6	0	0	90	11,799.3	10.4
8	0	0	32	14,869.7	1	70.2	33	14,939.9	13.2
9	16	228.0	4	1,053.3	1	43.2	21	1,324.5	1.2
10	0	0	3	707.8	1	548.0	4	1,255.8	1.1
11	114	8,673.1	15	1,065.7	2	1,406.0	131	11,144.8	9.8
12	189	13,536.5	6	3,466.6	0	0	195	17,003.1	15.0
13	38	4,425.0	0	0	3	870.0	41	5,295.0	4.7
SUB-TOTAL	805	$47,790.3	104	$34,441.1	29	$ 8,276.4	938	$ 90,507.8	79.8
Tributary									
1	73	3,776.1	0	0	0	0	73	3,776.1	3.3
2	37	1,986.9	1	90.0	0	0	38	2,076.9	1.8
3	22	1,956.9	0	0	0	0	22	1,956.9	1.7
4	43	3,824.9	14	8,988.6	0	0	57	12,813.5	11.3
5	26	2,312.7	0	0	0	0	26	2,312.7	2.1
SUB-TOTAL	201	$13,857.5	15	$ 9,078.6	0	$ 0	216	$ 22,936.1	20.2
TOTAL	1,006	$61,647.8	119	$43,519.7	29	8,276.4	1,151	$113,443.9	100.0
PERCENT OF TOTAL		54%		39%		7%		100%	

Upon critical analysis of the information in Table 1-C-5, the conclusion could be drawn that the residential interests in the Upper Gordons Creek flood plain could potentially incur the greatest level of economic loss as opposed to the other categories. But this potential for economic loss is not only a function of the total value of damageable development in the flood plain, but also is dependent on the location of individual structures with reference to the thalweg of the flood producing stream, and the first floor elevations of individual structures relative to the water surface of various frequency floods. Applying these variables to all categories of structures in the flood plain produced the data displayed in Table 1-C-6. The table indicates for any one of seven flood frequencies, the actual damages occurring to all development which has first floor elevations at or below the water surface of a particular frequency flood. The table is cumulative in the sense that structures sited below the specified flood events are also inundated and, therefore, included in totals shown for each specified flood event. It should be noted that structures which may lie within the areal boundary of a particular frequency flood, but whose first floor is above the water surface of that particular flood, are not included in the damage figure for that flood.

AVERAGE ANNUAL EQUIVALENT FLOOD DAMAGES

General. Flood damages accruing to the flood plain properties in the study area under existing conditions, without the implementation of a Federal project, are discussed in the subsequent paragraphs. Also discussed are the effects of possible future changes in the physical makeup of the flood plain properties and their effects on the value of flood damage. Damage categories which are projected to increase over time are summed at present value, amortized over the 50-year period of 1987 to 2037 and presented along with existing flood damages as a total figure expressed as "average annual equivalent flood damage."

TABLE 1-C-6
Upper Gordons Creek
Damage-Frequency Table - All Property
November, 1982 Prices/Development
(1,000)

Reach	Frequency of Flood (Years)						
	5	10	25	50	100	500	SPF
Main Stem							
3	0	6.48	17.20	56.14	91.90	200.96	951.36
4	599.44	1,076.52	1,565.88	1,966.42	2,329.98	2,738.84	3,637.29
5	0	5.02	18.91	51.33	90.38	195.52	424.03
6	64.58	119.87	163.35	201.17	258.37	425.78	756.26
7	27.37	95.27	208.55	301.36	375.08	559.42	1,070.68
8	324.33	422.00	457.50	907.89	1,642.91	2,881.81	3,292.55
9	255.94	364.20	370.22	374.64	383.84	406.84	497.25
10	0	0	0	4.88	24.40	98.18	180.92
11	560.58	834.15	1,005.06	1,103.60	1,207.20	1,552.45	2,619.44
12	176.67	526.64	1,038.54	1,720.34	2,098.13	2,848.70	3,932.14
13	385.92	684.45	778.05	897.54	1,011.46	1,233.54	1,561.82
	2,394.83	4,134.60	5,623.26	7,585.31	9,513.65	13,142.04	18,923.74
Tributary							
1	24.96	73.52	182.65	378.45	443.63	715.16	1,451.80
2	0.08	2.61	17.67	37.12	61.76	107.83	145.98
3	25.47	95.82	187.92	305.43	445.15	683.51	717.90
4	0	12.78	60.07	431.48	580.07	1,201.54	1,837.70
5	0	17.04	72.74	212.96	246.60	402.14	476.80
	50.51	201.77	521.05	1,365.44	1,777.21	3,110.18	4,630.18
TOTALS							
	2,445.34	4,336.37	6,144.31	8,950.75	11,290.86	16,252.22	23,553.92

Damage Calculation Procedure. Quantification of flood damage is a process involving the integration of relevant data on flood plain development with hydraulic data on flooding. Flood damage is traditionally expressed in terms of a dollar amount on an average annual basis. The determination of this average annual amount of damage incorporates, primarily, three types of relationships: flood elevation vs. frequency of occurrence (elevation-frequency curves); depth of inundation vs. percent of value damaged for each type of flood plain development (depth-percent damage curves); and elevations of the various types of development vs. the flood elevations for various flood frequencies indexed to their particular site. The computation process can be divided into two major segments: the first segment results in the determination of an overall relationship between flood elevations in a particular subreach and the total dollar amount of damage which results at any given flood elevation in the subreach (damage to all the types of development summed as a single dollar amount); the second segment combines the elevation-damage relationships in each subreach with elevation-frequency, to produce a damage-frequency relationship. The results of the first major segment are expressed as a plotted curve for each subreach termed "Elevation-Damage Curve." The results of the second major segment are usually presented as a plotted curve termed "Damage-Frequency Curve." These two major computational segments, for purposes of this study, were accomplished by the application of two separate computer programs.

A program which was developed by the Galveston District, Corps of Engineers, and modified by the Mobile District for application to this study, was utilized to compute the Elevation-Damage data for each subreach. The midpoint of each subreach was used as an index point to relate structure elevations to flood elevations for each development type. First floor elevation and elevation of first damage for each structure were adjusted to the index point of their respective subreaches by adding or subtracting elevation to allow for the slope of the water surface in the subreach. Input data on damage per increment of inundation occurring to each type of structure, input as depth versus percent of value damaged functions, were defined by Corps of Engineers Mobile District personnel using historical information. In the case of the damage category of residential development, depth-percent damage curves were

used as developed by the Federal Insurance Administration in 1970. The Galveston District program outputs separate elevation damage data for each subreach by damage category, and as a total for the subreach. From this output elevation-damage curves can be plotted for each subreach if desired. This aggregated damage data for the subreach is indexed to the flood elevations at the midpoint of the subreach only. Thus far, no consideration of flood frequency has been made in the computational procedure.

For the purpose of producing damage-frequency curves for each subreach and computing the average annual damage amounts, the Expected Annual Flood Damage (EAD) computer program developed by the Corps of Engineers Hydrologic Engineering Center at Davis, California, was utilized. Input data used by this program included elevation-frequency relationships for the index point of each subreach and the elevation-damage data output for each subreach by the previously described program. The elevation-frequency data which was used is a correlation of flood elevation with the expected average interval in years for the probable occurrence of the particular elevation at the index point. These correlations were taken from the output data of the backwater computation model (HEC-2) utilized for hydraulic computations in this study. Plotted flood profiles for various flood frequencies are included in Appendix 2 of this report. Using flood elevation as a common parameter, elevation-damage and elevation-frequency data are combined to produce damage-frequency data for each subreach and major reach in the Upper Gordons Creek flood plain. See Table 1-C-6 for damage-frequency data on the entire flood plain. This correlation process was performed by the EAD computer program for each damage category, subreach and major reach in the flood plain. These correlations, once developed, form the basis from which the calculation of average annual damage is made.

The conversion of the damage-frequency data (or flood damage incurred from any one flood frequency event) into flood damage on an average annual basis is accomplished by summing the products of the incremental probability of occurrence between two flood events and the average damages incurred for the two flood events over the entire range of flood probability. For purposes of this study, the probability range from the frequency of zero damage up to the 1,000-year exceedance interval event was used.

Existing Condition Damages. Using the previously described method, average annual flood damage was calculated for the Upper Gordons Creek flood plain with existing flood plain development and prices. Results of those calculations show that a total of $1,341,980 of average annual damage would accrue to flood plain occupants under these conditions. Approximately 73 percent of those damages ($984,810) would accrue to residential property owners (structure and contents). Commercial properties would sustain $216,270 of average annual damage or 16 percent of the total. The remaining 11 percent of these damages would be incurred by institutional properties, roads, and railroads, etc. Shown in Table 1-C-7 is a summary of the existing condition average annual damages in the flood plain by reach and damage category.

Without-Project Condition Damages. The difference between the previously presented damage figures, and those which fall under this heading, are due to differences in the level of flood plain development under existing conditions and those which might be reasonably expected to exist during the period from 1987 to 2037 (period for which a project might reduce damages).

Due to the density of development in the existing flood plain, no real future growth is anticipated; however, inflation may increase the relative value of the present development to some extent. The Water Resource Council Procedures (WRC) for the evaluation of National Economic Development (NED) benefits and costs in water resources planning stipulate that affluence factors can be applied to the value of the contents of residential structures. It further states that the increased value of contents cannot exceed 75 percent of the existing value of the structure. The growth in value of contents is in direct relationship to the growth in per capita income for Forrest County, Mississippi, in which 98 percent of the land area of the flood plain being studied is located. It was assumed that the value of contents for single residential units equalled 50 percent of the structure value. The same assumption was made for multi-family residential units in the flood plain. This afforded a simple approach to determine future increases in the accumulation of personal property (contents) by the flood plain occupants. Table 1-C-8 depicts the derivation of the affluence factor.

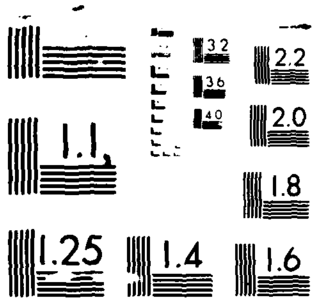
TABLE 1-C-7
Upper Gordons Creek
Summary of Average Annual Damages
to Existing Development by Reach, By Category
November, 1982 Prices/Development
($1,000)

Reach	Residential Structure	Residential Contents	Commercial	Public	Other 1/	Total
Main Stem						
3	2.49	1.40	0.03	0.34	0.51	4.77
4	161.12	114.39	0.04	0.61	34.04	310.20
5	1.62	0.92	0.03	0.75	0.40	3.72
6	17.94	12.29	0.00	0.00	3.68	33.91
7	16.50	8.77	0.10	0.00	3.28	28.65
8	0.00	0.00	125.64	0.00	15.46	141.10
9	2.32	1.68	77.52	0.20	10.05	91.77
10	0.00	0.00	0.59	0.20	0.10	0.89
11	142.93	103.72	0.02	1.34	30.50	278.51
12	88.53	57.85	0.34	0.00	18.09	164.81
13	101.40	68.83	0.00	0.30	20.98	191.51
Sub-Total	543.85	369.85	204.31	3.74	137.09	1,249.84
Tributary						
1	15.51	10.24	0.00	0.00	3.15	28.90
2	1.49	0.71	0.00	0.00	0.27	2.47
3	15.37	10.73	0.00	0.00	3.19	29.29
4	4.18	2.37	11.96	0.00	2.27	20.78
5	6.20	3.31	0.00	0.00	1.19	10.70
Sub-total	42.75	27.36	11.96	0.00	10.07	92.14
TOTALS	577.60	397.21	216.27	3.74	147.16	1,341.98
Percent	43.0%	29.6%	16.1%	0.03%	11.0%	100.0%

1/ Transportation, Communications and Utilities (based upon historical outlays by the City of Hattiesburg for these systems).

AD-A179 191 DETAILED PROJECT REPORT AND ENVIRONMENTAL ASSESSMENT ON 2/5
UPPER GORDONS CRE..(U) CORPS OF ENGINEERS MOBILE AL
MOBILE DISTRICT SEP 86 COESAM/PDW-86/004

UNCLASSIFIED F/G 13/2 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS

TABLE 1-C-8

Affluence Factors

Forrest County, Mississippi, Per Capita Income (1972 Dollars 1/)

YEAR	PER CAPITA INCOME
1978	4,155
1983	4,895 2/
1985	5,191
1987	5,547 2/
1990	6,082
1995	6,958
1997	7,377 2/
2000	8,006
2010	10,246
2020	12,449
2030	15,336
2040	18,892

Total Value, Residential Structures	$41,098,500
Total Value, Residential Contents	20,549,300
75% Total Value, Residential Structures	30,823,875
Growth Rate, Per Capita Income, 1983 to 1987	1.13
Growth Rate, Per Capita Income, 1987 to 1990	1.10
Growth Rate, Per Capita Income, 1990 to 1997	1.21 3/
Value of Contents, 1986	22,398,737
Value of Contents, 1996	30,823,875

1/ County-Level Projections of Economic Activity & Population, Miss, 1985-2040; BEA, USDC, December, 1982.

2/ Interpolated.

3/ A factor of 1.206755 was used to conform to the 75% rule.

The incorporation of the affluence factor into the computation of average annual flood damage, to allow for the increase in flood damage to residential contents over the time period 1987 to 2037, was the only difference between existing condition and without-project condition flood damages. Since the benefit and cost comparison for any flood damage reduction plan must be made on an equivalent basis, and since costs and damage dollars must be for some single point in time, these increases in content value must be reduced to an average annual figure. The procedure used to compute this average annual equivalent flood damage is essentially the same as that used to compute loan amortization by US lending institutions. That is, the present worth of all future damages is summed at a chosen interest rate and then amortized over the life of the project.

For purposes of this study, the period of analysis is 50 years and the remaining physical life of all structures is estimated to be 50 years. Specifically, all structures will be assumed to be continually maintained or repaired to preflood conditions as circumstances dictate. According to current planning guidelines, the interest rate to be used for Fiscal Year 1985 is set at 8.625 percent. To compute the average annual equivalent flood damage for the without project condition, a computer program was used which discounts the first year damages, and uses straight line interpolation between data points. Shown in Table 1-C-9 is a summary of average annual equivalent flood damage for without-project conditions broken down by damage category and major damage reach. The total average annual equivalent flood damage shown in the table without project conditions is $1,489,870 for a 50-year project life.

TABLE 1-C-9
Upper Gordons Creek
Summary, Average Annual Equivalent (AAE) Damages @ 8.625 Interest Rate,
By Category, By Reach for Without-Project Condition
($1,000)

Damage Category and Reach	1983 (Existing)	1987 (Base Year)	1990	1997	1998-2037	50-Year AAE (1987-2037)
Residential Contents						
3	1.40	1.58	1.74	2.10	2.10	1.92
4	114.39	129.26	142.19	171.59	171.59	156.99
5	0.92	1.04	1.14	1.38	1.38	1.26
6	12.29	13.89	15.28	18.44	18.44	16.87
7	8.77	0.91	10.90	13.15	13.15	12.03
8	0.00	0.00	0.00	0.00	0.00	0.00
9	1.68	1.90	2.09	2.52	2.52	2.31
10	0.00	0.00	0.00	0.00	0.00	0.00
11	103.72	117.20	128.92	155.58	155.58	142.34
12	57.85	65.37	71.91	86.77	86.77	79.39
13	68.83	77.78	85.56	103.24	103.24	94.46
T-1	10.24	11.57	12.73	15.36	15.36	14.05
T-2	0.71	0.80	0.88	1.06	1.06	0.97
T-3	10.73	12.12	13.34	16.09	16.09	14.72
T-4	2.37	2.68	2.95	3.55	3.55	3.25
T-5	3.31	3.74	4.11	4.96	4.96	4.54
Sub-Total	397.21	448.84	493.74	605.79	605.79	545.10
All Other Categories						
3	3.37	3.37	3.37	3.37	3.37	3.37
4	195.81	195.81	195.81	195.81	195.81	195.81
5	2.80	2.80	2.80	2.80	2.80	2.80
6	21.62	21.62	21.62	21.62	21.62	21.62
7	19.88	19.88	19.88	19.88	19.88	19.88
8	141.10	141.10	141.10	141.10	141.10	141.10
9	90.09	90.09	90.09	90.09	90.09	90.09
10	0.89	0.89	0.89	0.89	0.89	0.89
11	174.79	174.79	174.79	174.79	174.79	174.79
12	106.96	106.96	106.96	106.96	106.96	106.96
13	122.68	122.68	122.68	122.68	122.68	122.68
T-1	18.66	18.66	18.66	18.66	18.66	18.66
T-2	1.76	1.76	1.76	1.76	1.76	1.76
T-3	18.56	18.56	18.56	18.56	18.56	18.56
T-4	18.41	18.41	18.41	18.41	18.41	18.41
T-5	7.39	7.39	7.39	7.39	7.39	7.39
Sub-Total	944.77	944.77	944.77	944.77	944.77	944.77
Totals	1,341.98	1,393.61	1,438.51	1,550.56	1,550.56	1,489.87

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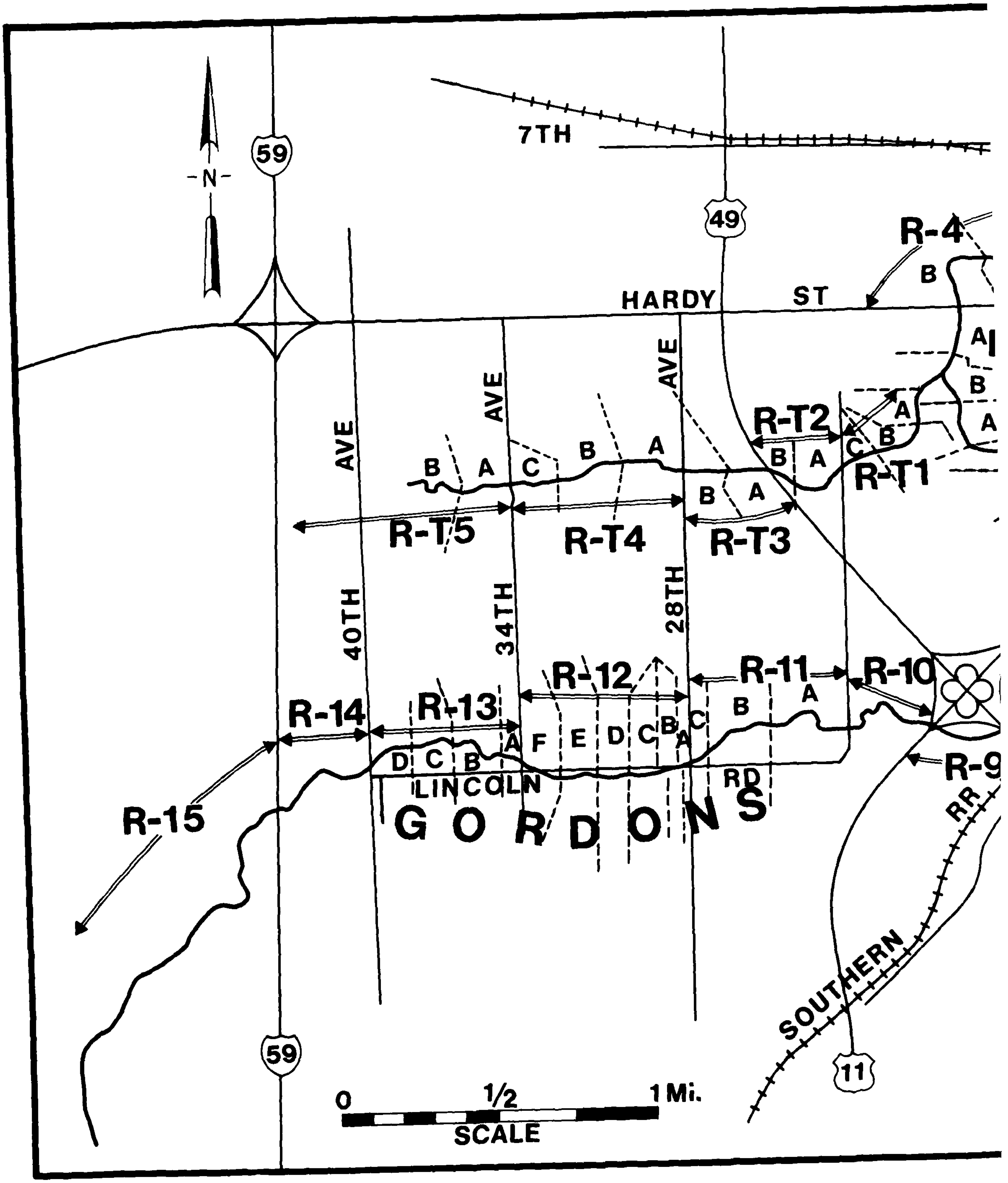
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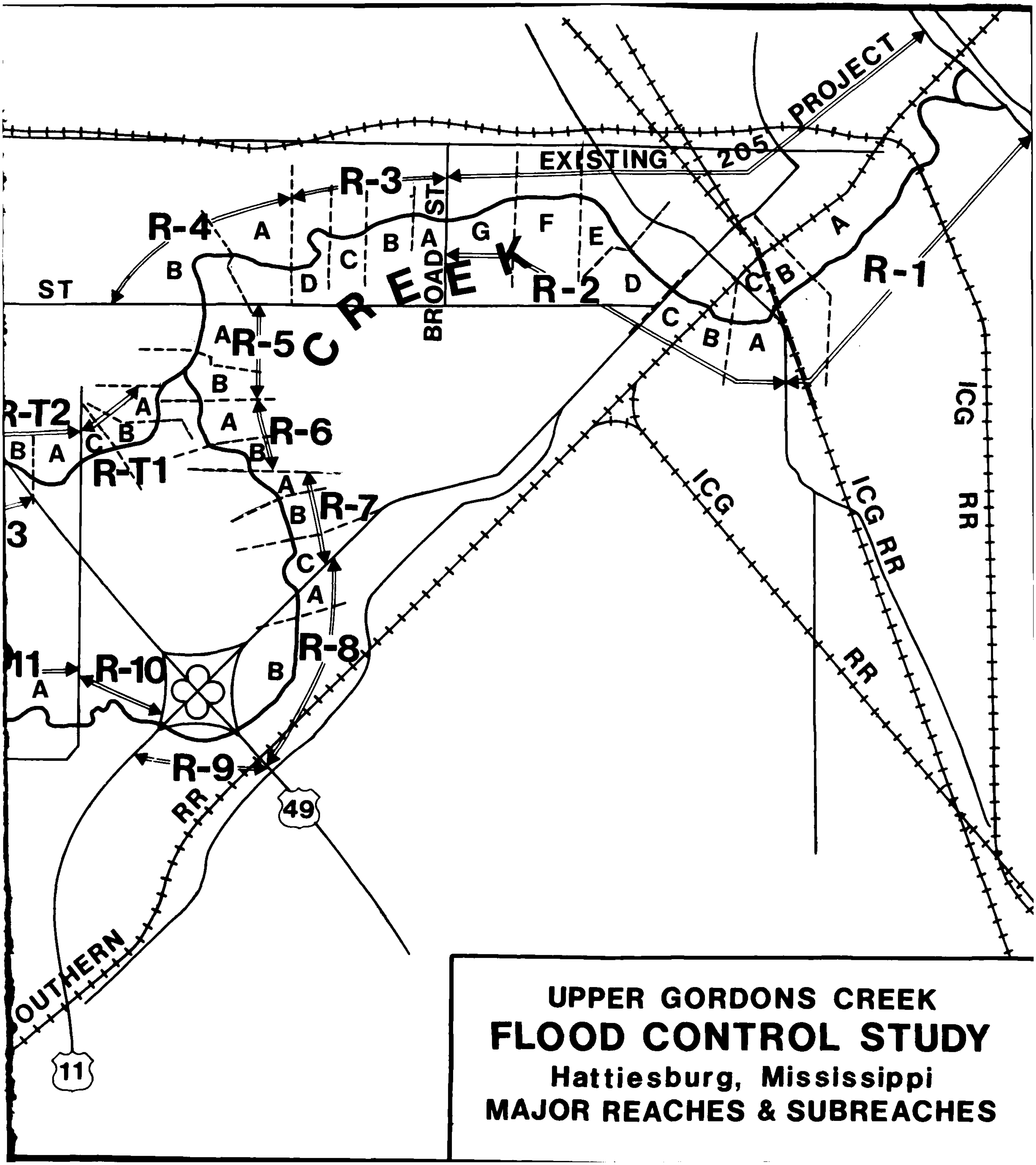

UPPER GORDONS CREEK

FLOOD CONTROL STUDY

Hattiesburg, Mississippi

MAJOR REACHES & SUBREACHES

SECTION D

DETERMINATION OF NED BENEFITS FOR FLOOD REDUCTION MEASURES-- INITIAL STAGE PLANNING

GENERAL

The previous sections have described the flood plain from both socio-demographic and economic development standpoints. This Section will describe the assumptions and methodology used to derive benefits for both structural and nonstructural meaasures which was considered for reducing flood damages in the Upper Gordons Creek flood plain.

ASSUMPTIONS AND METHODOLOGY

An assumption used in Section C must be expounded. The premise that no real growth is expected in this flood plain (since the flood plain is 98 percent developed under Existing Conditions) does not preclude shifts in types of development (i.e., residential to commercial, etc.). It is assumed, however, that if shifts in development do occur that there will be no appreciable changes in average annual damages for the whole flood plain since the City of Hattiesburg's continued participation in the National Flood Insurance Program (NFIP) will regulate any new development. Should shifts in development create more intensified land use, no intensification benefits will be pursued in this analysis since the City of Hattiesburg does not have an approved comprehensive development plan which would be required to base such development shift decisions. Any plan considered to reduce damages, then, will be compared to average annual damages in the flood plain under Existing Conditions.

The methodology for determining damages reduced in the flood plain by a plan is based upon the same procedures mentioned in Section C; or simply, the Existing Conditions stage-damage curve is integrated with the plan's

reduced/lowered stage-frequency curve to produce average annual damages reduced/remaining in the flood plain with the plan.

TYPES OF MEASURES CONSIDERED

Numerous structural and nonstructural measures were considered for reducing flood damages in the flood plain (see the Formulation Appendix); however, only two structural measures (diversion and channel enlargement) and one nonstructural measure (evacuation) were further analyzed for damage reductions, or, benefits. A description and the derivation of benefits for each of these measures are presented in the following paragraphs.

Structural Measures: A diversion plan (into Burketts Creek) and numerous channel enlargement plans warranted detailed economic analysis (see the Formulation Appendix for exact descriptions). In general, the diversion plan diverted some of the flood waters from above Highway 49, along Highway 49 and into the first major stem of Burketts Creek. The channel enlargement plans start at Broad Street with successively longer and wider increments until the most efficient plan was identified. Table 1-D-1 shows the flood damage reductions only for each of these plans.

Nonstructural Measures: Evacuation of structures in the more frequent flood zones was the only viable plan of the nonstructural measures (see the Formulation Appendix for reasons for excluding other types of nonstructural plans). The methodology for determining benefits accruing to an evacuation plan is in accordance with Water Resource planning guidelines (ER 1105-2-40) and October, 1985 NFIP guidelines. In general, all private costs of flood plain occupants (insurance, premium, deductible and non-insurable losses) are subtracted from public costs (flood damages and insurance policy overhead) to arrive at insurable flood losses which are the benefits for evacuating structures from a flood plain. All these costs (private and public) which are not annual costs are converted to an average annual basis through the traditional integration of stage-frequency-damage (private cost) relationships.

TABLE 1-D-1

Flood Damage Reductions -

Structural Plans

Upper Gordons Creek

($1,000)

Plan #	Type Plan	Existing Conditions Damages	Damages Remaining	Damages Reduced
13	Diversion	$1,272.82 1/	$ 969.52	$303.30
21	Channel Enlargemt	1,272.82	1,034.23	238.59
22	Channel Enlargemt	1,272.82	803.45	469.37
23	Channel Enlargemt	1,272.82	608.08	664.74
24	Channel Enlargemt	1,272.82	349.10	923.71
25	Channel Enlargemt	1,272.82	300.32	972.49
26	Channel Enlargemt	1,272.82	283.71	989.10

Note: Plans 21-26 established the optimum length of channel enlargement.

1/ All plans were analyzed during this stage of planning using hydraulic data which produced damages of $1,272,820.

The resulting analysis of the evacuation of the 10-year flood plain is presented in Table 1-D-2 as Plan 31. Partial evacuation of the 10-year flood plain (feasible structures only) is presented in Table 1-D-2 as Plan 32. As can be seen on Table 1-D-2, Plan 31 is not a feasible alternative. Plan 32, though feasible, reduces only 16 percent of the flood damages in the entire flood plain ($212,721) divided by $1,341,980), and could not be recommended as the singular solution to flooding problems along Upper Gordons Creek.

SUMMARY OF INITIAL STAGE PLANNING

In general, the most efficient structural plan was identified as Plan 24, which is a channel enlargement of a 40' bottom width from Broad Street to 28th Avenue, and a 30' bottom width from 28th Avenue to 40th Avenue (no structural alternative was economically justified on the tributary). Nonstructurally, Plan 32 could be carried to the next planning phase as a viable alternative when combined with a structural plan.

Table 1-D-2

Evacuation Plans Considered

Upper Gordons Creek

Plan	Title	Number Structures Res.	Number Structures Other	PUBLIC COSTS A.A. Flood Losses (+)	PUBLIC COSTS Policy Overhead (+)	PRIVATE COSTS A.A. Deductible (-)	PRIVATE COSTS Insurance Premiums (-)	PRIVATE COSTS A.A. Non-Insur. Losses (-)	Benefits 2/	Costs 3/	Benefit to Cost Ratio
31	Evacuate 10 yr Floodplain	162	10	$757,670	$8,772	$22,120	$49,225	$12,860	$682,227	$981,945	0.76
32	Partially evacuate 10-yr Floodplain 1/	17	1	212,721	918	5,724	6,268	12,860	188,787	98,745	1.91

1/ Feasible structures only

2/ These are insurable flood losses only.

3/ Excludes demolition and acquisition costs

Note: "A.A." = Average Annual

SECTION E

DETERMINATION OF NED BENEFITS FOR FLOOD REDUCTION MEASURES--FINAL STAGE PLANNING

GENERAL

The most efficient structural measure and its length (channel enlargement over the entire stream) was carried to this planning phase along with a feasible nonstructural measure. Refinement of both measures is accomplished in this Section (width, bridge modification, etc. for the channel enlargement; and identification of that portion of flood losses in the evacuation plan accruing to the channel enlargement plan if it were "first-added" and the evacuation plan were "second-added"). Another topic, the effects of a structural plan implemented on Upper Gordons Creek upon the existing project (Lower Gordons Creek), will also be discussed and evaluated in this Section.

ASSUMPTIONS AND METHODOLOGY

When structural and nonstructural plans are candidates for a mixed plan to solve flooding problems, project planning criteria dictates that after combining, each element (plan) must be incrementally feasible after the combining process, or in both first- and second-added positions. The least comprehensive plan for eliminating damages along the basin will, mathematically, have the least chances of surviving the second-added test. The evacuation plan was presented to the Hattiesburg public, January 30, 1985 and was not met with a favorable reaction as their singular choice for solving their flooding problems. It was also evaluated in the second-added position for continued economic feasibility; and the resulting benefit-to-cost ratio dropped to 0.51, which eliminated its further consideration as a possible component of a mixed plan.

Further engineering refinement of the channel enlargement plan, Plan 24, for the most efficient width followed the methodology for economic analysis presented in Section C of this Appendix. Specifically, the Existing Conditions stage-damage curve was integrated with the stage-frequency curve of the each successive new width alignment for Plan 24. Design efficiency was reached within two (2) alternatives of Plan 24, since the existing concrete-lined channel of the Kamper Park area of the flood plain dictated the stream's flow capacity upstream of this Park. These two alternative widths were numbered Plans 24A and 24B. Their descriptions and damage reductions are presented in Table 1-E-1 below:

TABLE 1-E-1
Comparison of Plans 24A and 24B
Upper Gordons Creek
1 November 1982 Prices and Development
($1,000)

Plan No.	Description	Existing Conditions Damages	With Plan Damages Remaining	With Plan Damages Removed
24A	40' B/W Broad to Hardy; 30' B/W thereafter	$1,341.98 1/	$399.47	$942.51
24B	40' B/W Broad to Hardy; 30' B/W thereafter to 28th; 20' B/W 28th to 40th Avenue	1,341.98	413.66	928.32

Note: "B/W" = Bottom Width

1/ Updated to 1 Oct 1985 prices = $1,426,450

Based upon comparisons with costs, Plan 24B produced greater net benefits above costs and was the tentatively selected plan. New bridge alignments (straightening the channel) at 28th and 34th Avenues, afforded further design efficiency of Plan 24B and were both economically feasible components. With these additional components, reductions in flood damages were $937,600 with Plan 24B.

FORMULATION OF ALTERNATIVES OF PLAN 24B

After Plan 24B was presented to the City of Hattiesburg as the selected plan, the city felt that this was too costly and would be difficult to implement along the stream from Kamper Park to Highway 11 (Subreaches 5B, 6A, 6B, 7A, 7B, and 7C); and OCE requested that bridge modifications be tested for economic feasibility at both Highway 11 crossings and at Highway 49. Both new channel plans, numbered 27 and 28, used the channel design of Plan 24B. Plan 27 excluded the portion of the channel works from Kamper Park to Highway 11, and Plan 28 excluded the channel works from Kamper Park to Highway 49. Modification of the three bridges, numbered plan 51, was formulated in an attempt to afford protection to the residential area from Kamper park to Highway 11 which was excluded in Plans 27 and 28. Table 1-E-2 shows the resulting benefits to Plans 27, 28 and 51 in comparison to Plan 24B. Plan 51 induced damages (raised stages) from Reach 9 to Broad Street (the most downstream reach of the study area) and was given no further consideration as a viable alternative, even when combined with Plan 27 or 28. No protection to the commercial properties located within the 10-year flood plan in Reach 8 eliminated Plan 28 from further consideration (e.g., channel work throughout Reach 8 is economically justified). Plan 27 was the NED plan and the selected plan.

TABLE 1-E-2
Flood Damages Reduced with Plans 24B, 27, 28 and 51
($1,000)

* *

UPPER GORDONS CREEK DPR
AVERAGE ANNUAL DAMAGES
NOVEMBER 1982 PRICES AND DEVELOPMENT

** GRAND SUMMARY BY CATEGORY **

** FLOOD PLAIN MANAGEMENT PLANS
1 - EXISTING CONDITIONS (REVISED NOV. 25,1985)
2 - PLAN 2-4B: 40' BW BROAD/HARDY; 30'-28TH; 20'-40TH (STRAIGHT @ 28TH/34TH)
3 - PLAN 2-7: PLAN24B EXCLUD. CHANNEL FM KAMPER PARK TO HWY 11
4 - PLAN 2-8: PLAN24B EXCLUD. CHANNEL FM KAMPER PARK TO HWY 49
5 - PLAN 5-1: MODIFY 3 BRIDGES (HWY 11, 49 & 11)

GRAND SUMMARY - ALL DAMAGE CATEGORIES

	.... EXPECTED ANNUAL DAMAGE								
DAMAGE CATEGORY	BASE CONDITION (PLAN 1)	.... PLAN 2.... DAMAGE W/PLAN	DAMAGE REDUCED	.... PLAN 3.... DAMAGE W/PLAN	DAMAGE REDUCED	.... PLAN 4.... DAMAGE W/PLAN	DAMAGE REDUCED	.... PLAN 5.... DAMAGE W/PLAN	DAMAGE REDUCED
RES STR	577.60	179.90	397.70	215.34	362.26	213.84	363.76	593.53	-15.94
RES CNTS	397.20	118.93	278.27	141.51	255.69	140.37	256.83	408.79	-11.59
COMMER	216.28	60.77	155.51	77.69	138.59	204.68	11.60	193.27	23.01
PUBLIC	3.75	0.53	3.23	0.50	3.25	0.45	3.30	3.77	-0.02
INDUST	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AG/F/F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MARINE	0.17	0.00	0.17	0.15	0.01	0.15	0.01	0.19	-0.02
TRANSPOR	23.87	7.19	16.68	8.69	15.18	11.17	12.70	23.97	-0.10
COM/UTIL	45.39	13.68	31.72	16.53	28.87	21.26	24.14	45.57	-0.18
P/RELIEF	77.73	23.41	54.33	28.26	49.48	36.34	41.39	78.04	-0.30
TOTAL	1341.99	404.40	937.60	488.67	853.32	628.27	713.72	1347.14	-5.15

NONSTRUCTURAL COMPONENT OF PLAN 27

Considering that Plan 27 has no channel works from Kamper Park to Highway 11, evacuation of structures within the 10-year flood plain could be a feasible component. Based upon the methodology used on page 1-D-2, evacuation of the 10-year flood plain in Subreaches 5B, 6A, 6B, 7A, 7B and 7C produced a benefit-to-cost ratio of 0.46. Individually feasible residential structures within these reaches are shown in Table 1-E-3, which identifies nine (9) structures by addresses for evacuation. The benefit-to-cost ratio for evacuating these structures is 1.33 in second-added position (with Plan 27 in place). This nonstructural component will hereafter be a part of Plan 27.

Table 1-E-3
Feasible Evacuation of Residential Structures in Subreach 6A and 6B With Plan 27 in Place
($1,000)

Residential Address	AA Externalized Costs: Flood Losses (+)	AA Externalized Costs: Policy O/H Reductions (+)	AA Internalized Costs: Insurance Premiums (-)	AA Internalized Costs: Deductible (-)	AA Internalized Costs: Non-Insurable Flood Losses (-)	A.A Benefits
1714 Brooklane	5,975	57	225	130	0	5,677
1716 Brooklane	5,975	57	225	130	0	5,677
1717 Brooklane	5,975	57	225	130	0	5,677
1702 Brooklane	3,429	57	225	70	0	3,191
1704 Brooklane	3,429	57	225	70	0	3,191
1708 Brooklane	3,429	57	225	70	0	3,191
1710 Brooklane	3,429	57	225	70	0	3,191
1712 Brooklane	3,429	57	225	70	0	3,191
416 17th St.	3,339	57	225	70	0	3,101
Totals	38,409	513	2,025	810	0	36,087

Residential Address	Costs 1/: Total Struct.	Costs 1/: Total Lot	Costs 1/: A.A.	B/C Ratio
1714 Brooklane	29,400	5,000	3,015	1.88
1716 Brooklane	29,400	5,000	3,015	1.88
1717 Brooklane	29,400	5,000	3,015	1.88
1702 Brooklane	29,400	5,000	3,015	1.06
1704 Brooklane	29,400	5,000	3,015	1.06
1708 Brooklane	29,400	5,000	3,015	1.06
1710 Brooklane	29,400	5,000	3,015	1.06
1712 Brooklane	29,400	5,000	3,015	1.06
416 17th St.	29,400	5,000	3,015	1.03
Totals	264,600	45,000	27,135	1.33

NOTE: A.A. = Average Annual

1/ Costs are annualized at 8-5/8% over a 50-year life.

BENEFITS OF PLAN 27

There are four (4) categories of benefits attributable to Plan 27. These are physical flood damages reduced by the plan (the basis for comparing all plans in the previous Sections of this Appendix); policy overhead reductions, which are claimable at $57 per insurance policy for those structures removed from the 100-year flood plain (285 structures); affluence benefits, which are damage reductions in future growth in residential contents attributable to Plan 27 over the life of the project, and insurable flood losses removed from the flood plain by evacuating nine (9) residential structures.

All costs shown in the Formulation Appendix are October, 1985 prices. All physical flood damages shown in Section C of this Appendix for Existing and Without-Project Conditions are November, 1982 prices and development; therefore, the reductions in flood damages and affluence benefits attributable to Plan 27 must be brought to October, 1985 levels. Table 1-E-4 summarizes these different price levels.

TABLE 1-E-4
Physical Flood Damages Reduction and
Affluence Benefits Attributable to Plan 27
($1,000)

Category	Nov. 1982 Prices	Oct. 1985 Prices
Residential Structures	$362.26	$387.62
Residential Contents	255.69	271.03
Commercial	138.59	144.83
Public	3.25	3.40
Other	93.53	100.08
TOTAL	$853.32	$906.96
Affluence Benefits	$61.60 1/	$65.30

1/ Affluence Benefits in the total flood plain are $96.26. See Table 1-C-9 (545.10 - 448.84 = 96.26) X 64%, or reductions in residential contents attributable to Plan 27 (255.69 divided by 397.20 in Table 1-E-2).

A summary of all categories and benefits afforded by Plan 27 are presented below in Table 1-E-5:

TABLE 1-E-5
SUMMARY OF BENEFITS FOR PLAN 24B
OCTOBER, 1985 PRICES
($1,000)

CATEGORY	BENEFITS
Flood Damage Reductions	$906.96
Policy Overhead Reductions	16.25
Affluence Benefits	65.30
Insurable Flood loss Reductions	36.10
Total	$1,024.61

EFFECTS OF PLAN 27 ON EXISTING PROJECT (LOWER GORDONS CREEK)

The existing project on Lower Gordons Creek covers Reaches 1 and 2 on Chart 1-C-1 (Section C of this Appendix). Components of this flood control project are clearing and snagging along Reach 1, and a 40' bottom-width channel improvement along Reach 2. This existing project protects portions of the downtown area of Hattiesburg from approximately a 15-year flood event.

There are 330 residences in the SPF flood plain of Lower Gordons Creek (74 percent in subreaches 1A and 1B; and 7 and 18 percents in subreaches 2F and 2G, respectively) valued at approximately $6 million dollars. There are 107 commercial and/or public buildings in the SPF flood plain valued at $12 million dollars, or, $28 million dollars in property in the total flood plain. Under Existing Conditions (with the existing project functioning), average annual damages in this flood plain are $72,650 (1 Oct 85 prices) with subreaches 2F and 2G receiving most of these damages (Hawkins Jr. High Auditorium in subreach 2E and three (3) small businesses on slab foundations on the creek bank in subreach 2D receive the next greatest increment of the total average annual damages under Existing Conditions).

If Plan 27 were constructed, average annual damages on Lower Gordons Creek would increase an additional $27,480, or, $100,130 in total (1 Oct 1985 prices). Subreaches 2F and 2G will incur 82% of this increase (2D and 2E will incur 11% of the increase, and 7% will be spread over the remainder of the flood plain). In general, most of the increases in water surface elevations on Lower Gordons Creek caused from implementation of Plan 27 occur immediately downstream of Broad Street.

Numerous nonstructural alternatives to mitigate these increased damages were analyzed for economic feasibility (levees, floodproofing, evacuation, etc.). Floodproofing (raising) 12 houses in subreach 2F and 9 houses in 2G to the 100-year event and placing a ring levee around one (1) commercial establishment in 2F produced the greatest net benefits and was recommended to the City of Hattiesburg for mitigation of Plan 27 (see the Formulation Appendix for further details).

SOCIO-ECONOMIC EVALUATION OF PLAN 27

General. The NED plan is Plan 27, which includes a 40-foot channel from Broad Street to Hardy Street; no channel works from Kamper Park to Highway 11; a 30-foot channel then to 28th Avenue; a 20-foot channel thence to 40th Avenue with new bridge alignments at 28th and 34th Avenues. Each component of this plan has possibly both sociological and economic impacts on the flood plain and its occupants, which will be discussed below. Also, the risk and uncertainty of the benefits attributable to this plan shall be included in a sensitivity analysis which follows an impact assessment.

Impact Assessment: Based upon data presented in Table 1-E-5, 29 percent of the flood damages remain in the flood plain with Plan 27. Conversely, 71 percent of the flood damages are eliminated with Plan 27. Based upon Table 1-E-5, an assessment of risk and uncertainty upon social and economic impacts of the implementation of Plan 27 can be made for the flood plain:

Economic Impacts:

1. National Economic Development: The NED account will be enhanced since federal expenditures to flood victims (loss reimbursements and subsidized insurance rates) will be reduced.

2. Tax Revenues/Property Values: Beneficially to the City of Hattiesburg, MS, property values will increase with flood hazard reductions and thus, tax revenues will increase. Adversely, affected flood plain occupants would pay the increased taxes.

3. Public Facilities/Services: Flood hazard reductions will decrease outlays for damaged city streets and utilities.

4. Regional Economic Development: No significant impacts will occur.

5. Employment/Labor Force: Beneficial effects will occur with employment during construction of the project.

6. Business/Industrial Activity: Beneficial effects will occur by reducing shutdown time and cleanup activities.

7. Possible Overall Changes in Local Income Stream: Based on the results of studies of a flood control project in Chester, Pennsylvania, property values will increase by approximately the same amount that flood damages are reduced in flood-prone areas with Plan 27. There would be a corresponding increase in property tax revenues. An increase of less magnitude should occur in the values of adjacent properties, again with an increase in tax receipts caused by the rise in property valuations.

   Construction incomes from repair of flood damaged property should decrease since the project will decrease the frequency and level of flooding in low-lying areas. However, inventories of commercial/industrial businesses in the affected floodplains may increase with the reduced flood hazard, which would increase local sales and sales tax bases. Expenditures for flood fighting and disaster relief by locals will also decrease, which would free these funds for more multiple income producing uses.

   Due to scarcity of available lands, another possible source of additional revenue as a result of the project could be the revitalization of formerly flood-prone areas (in compliance with federal flood plain management guidelines). This could include construction of new (or expansion of existing) residential and commercial structures with the accompanying increases in employment (construction worker) income, increases in property taxes, and increases in income for employees in the new or expanded commercial facilities (assuming that these facilities are not transferred from another part of the county).

Social Impacts:

1. Noise: Temporary adverse impacts will occur during project construction.

2. Population Mobility/Development: No significant impact.

3. Aesthetic Values/Leisure Opportunities: Temporary adverse impacts will occur from excavation/disposal of soil and debris during the channel enlargement and excavation phase of construction, however, long-term beneficial impacts on leisure opportunities will occur from the shaped, grassed/landscaped banks of the creek.

4. Historic Structures: No impact.

5. Housing: Beneficial impacts from the flood hazard reductions will result in more valuation comparability with housing outside the flood plain which will enhance the pride of ownership and thus enhance aesthetics of the flood plain.

6. Health: Reductions in possibly contaminated flood waters will reduce the possibility of outbreaks of typhoid fever, dysentery and hepatitis.

7. Community Cohesion: Families will be less prone to migrate out of the flood plain which will result in a better community cohesion.

8. Community Growth: No significant effects.

BENEFITS AND SENSITIVITY

The water surface elevation data used in this report is generated by the Hydrologic Engineering Centers "HEC-2" model, which is calibrated to a ± 0.5 feet of accuracy for each stage (elevation). Previous subjection of the water surface elevations in the Leaf/Bowie River flood plain at Hattiesburg/Petal, MS generated the following differences in damages:

CHANGES IN ELEVATIONS	% CHANGES IN DAMAGES
+ 0.50 feet	+ 16.5 percent
- 0.50 feet	- 14.4 percent

Stated simply, if all stages (elevations) needed to be raised 0.5 feet, benefits would be understated by 16.5 percent. Conversely, if the stages (elevations) needed to be lowered 0.5 feet, benefits would be overstated by 14.4 percent. Application of this latter, realistic sensitivity test produces the following average annual equivalent benefit differences from the most likely scenario, which is $1,024,610:

Most Likely AAE Benefits (all categories):	$1,024,610
Less: 14.4% Stage (elevation) Overstatement:	147,500
Least Likely AAE Benefits	$ 877,110

Understatement of stages (elevations) by +0.5 feet in the economic model could produce an additional $169,100 in damages, or a total of $1,193,710. However, it is felt that stages (elevations) are accurately analyzed and presented in this economic analysis.

APPENDIX 2

ENGINEERING INVESTIGATIONS

APPENDIX 2

ENGINEERING INVESTIGATIONS

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SECTION A

INTRODUCTION

This technical appendix contains sufficient engineering data and analyses to support the assumptions and subsequent findings utilized in formulating water resource plans for Upper Gordons Creek. The analyses were performed at a level of detail consistent with the overall study effort and with the degree of accuracy necessary to assure credible results. Included in this appendix are hydrologic, hydraulic, geotechnical investigations, and the construction cost estimates used in the study.

SECTION B

HYDROLOGIC INVESTIGATIONS

Scope. The hydrologic section contains the hydrologic data and studies which are the basis of the findings in the main report. Sixteen subareas were delineated for Gordons Creek and modelled in a HEC-1 computer model by use of USDA Soil Conservation Service (SCS) unit graphs. The HEC-1 model was calibrated to the April 1983 flood which was near the 100-year flood frequency at Broad Street. Special consideration was taken of the urbanizing nature of the basin, the construction of a federal channel modification below Broad Street, and a major tributary of Gordons Creek near the hospital.

Prior Reports. The Hattiesburg area was included in the "Pascagoula River Comprehensive Basin Report" published by the Corps of Engineers in 1963. Flood problems were identified and recommendations were made to reduce flood damages. The U.S. Geological Survey developed flood hazard maps for the Hattiesburg area in 1969 for the Flood Insurance Administration. The Corps published a "Flood Damage Study for Hattiesburg, Mississippi-Leaf and Bowie Rivers" in 1969 and the FIA printed flood insurance maps for the area. The Corps proposed a dam on Bowie Creek in the "Survey Report on Pascagoula River Basin, Mississippi and Alabama" dated 1972. The Corps has studied the downstream reach of Gordons Creek under Section 205 authority and published a Detailed Project Report dated August 1976 recommending channel improvements on the lower 2.35 miles. That project has been completed and is considered a part of the existing conditions. The Corps further studied the problems and in a "Detailed Project Report, Leaf and Bowie Rivers, Hattiesburg and Petal, Mississippi" dated April 1983 recommends clearing and snagging on the Leaf River and the removal of a Petal sewage lagoon from the flood plain. The April 1983 report is currently under review.

Basin Description. Gordons Creek drains about 75 percent of the city of Hattiesburg, Mississippi and is located 90 miles southeast of Jackson. The creek starts in Lamar County and flows eastward through Forrest County before it enters the Leaf River from the right bank at river mile 71.2 (above the Pascagoula River). The 10.01 square mile area was modelled with the HEC-1 computer program. The basin has stream slopes of seven feet per mile from the mouth to Hardy Street and 20 feet per mile from Hardy Street to Interstate 59, based on distances of 10.8 and 3.3 miles. The tributary entering the left bank, included in the study, above Hardy Street has a stream slope of 40 feet per mile. The basin elevations range from 135 to 400 feet NGVD. From the Leaf River to Broad Street, the creek has an average cross section width and depth of 60 to 80 feet, and 10 to 12 feet, respectively. From Broad Street to Hardy Street, the average width and depth is 20 to 40 feet and 6 to 10 feet, respectively. At Kamper Park, the channel is concrete lined for 1400 feet. The sixteen subareas are shown on Chart 2-B-1.

The Gordons Creek basin has been changing due to the channel modifications and urbanizations. A federal project was completed in 1979 on lower Gordons Creek. The project consists of clearing and snagging starting at the mouth and extending upstream 5880 feet followed by channel improvement to a 40-foot bottom width extending 6530 feet upstream to Broad Street. The federal project benefits the downtown area and older residential areas. However, the Leaf River has an effect on the lower Gordons Creek up to the Illinois Central Railroad due to the natural low ground elevation of around 142 feet National Geoditic Vertical Datum (NGVD). The federal channel improvement was never intended to alleviate the increasing flood damages in the rapidly developing regions in western Hattiesburg. The uppermost 3 mile reach, west of Highway 49, consists of new sub-divisions, commerical areas, and shopping centers. Flood flows are affected by buildings and structures near and over the channel and urbanization in the basin has increased runoff. Since the Detailed Project Report on Gordons Creek was approved, extensive residential and commerical development within the flood plain has occurred. As a result, flood problems of significance are experienced in area which previously incurred only moderate or minor damages from flooding. Due to the increased urbanization, several reaches have been realigned and the old channel filled in. The reach from Broad Street to Interstate 59 is the current study area.

Climatology. Some of the weather data contained herein was taken from the "Detailed Project Report for Leaf and Bowie Rivers, Hattiesburg and Petal, Mississippi" dated April 1983, and supplemented with information from National Weather Service (NWS) weather stations. The Hattiesburg area has long warm summers and short mild winters. The average temperatures at Hattiesburg, based on 81 years of record, is 66.7° F. Monthly average temperatures range from 52° F in December to 82° F in July. Maximum and minimum temperatures of 106° F and -1° F have been recorded. The annual precipitation, based on 81 years, is 60.18 inches. The Hattiesburg station normal rainfalls for 1941 through 1970 were 4.71, 5.71, 6.96, 5.03, 4.91, 4.26, 5.73, 5.14, 4.24, 2.53, 4.00, and 6.07 inches for January through December, respectively. At the nearest National Weather Service first order station located at Meridian, Mississippi about 80 miles NNE, the month of July has the highest rainfall with 6.79 inches and October the lowest with 2.70 inches. Rainfall averages 26 percent in the winter, 29 percent in the spring, 27 percent in the summer, and 18 percent in the fall.

Flood Problems. Flood-producing storms over the Gordons Creek watershed may occur at anytime. However, they are more numerous in the winter and spring when the lack of vegetation and the usually higher moisture content of the soils result in higher rates of storm runoff. Major flood-producing storms that occur in winter and spring generally last from 2 to 4 days and are usually of the frontal type covering large areas. Summer storms are usually of the thunderstorm type with high intensity rain over small areas.

In the last 40 years, four major floods occurred on the creek. They happened in 1947, 1957, 1961, and 1983. These floods inundated the flood plain to depths ranging up to 3.5 feet. The April 1983 flood caused runoff peaks slightly higher than the current studies estimated 100-year peaks. The flood resulted from heavy rainfall of up to 10.68 inches at William Carey College and 16 inches (in 14 hours) at the Civil Defense office in downtown Hattiesburg. In fact, the Civil Defense office recorded 11.35 inches of rainfall between 2 and 4 P.M. on April 6, 1983. A U.S. Geological Survey crew measured the water stage and velocities at Broad Street and computed a peak

discharge of 6750 cfs. It has been estimated from rainfall and high water marks below Broad Street that the April 1983 flood was approaching the 500-year event in that reach. This event was considered a flash flood due to a duration of less than six hours. The Leaf River did not cause any major damage in the Hattiesburg area for the April 1983 flood.

Stream Gages. U.S. Geological Survey has maintained a crest-stage (peak only) gage at Broad Street on Gordons Creek since 1969 and a recorder at Highway 11 on the Leaf River (above Gordons). The Gordons Creek record is mixed due to rapid urbanization of the watershed and the construction of the channel project below the Broad Street gage in 1979. Therefore, the basic data is presented but was not used in a stage-frequency analysis. The estimated 1961 stage and peak discharge is presented with the other annual peak values in Table 2-B-1. The Leaf River at Highway 11 has 1760 square miles of drainage area and the gage has been a recorder since 1938. The gage record has been extended back to 1904 by use of Weather Bureau peak stages. The Highway 11 gage was used to estimate starting Gordons Creek stages and the Leaf River peak stages near Gordons mouth. The Leaf River has higher stages than Gordons Creek up to Broad Street.

TABLE 2-B-1
GORDONS CREEK ANNUAL PEAK STAGE AND FLOW AT BROAD STREET
DA=8.83 Square Miles, USGS02473047

DATE	STAGE	PEAK
2-26-61	161.30	5400
4-14-69	157.10	1850
5-02-70	154.10	1080
3-02-71	156.64	1700
12-06-71	158.70	2620
3-24-73	160.06	3350
4-13-74	158.88	2710
5-07-75	159.26	2900
3-30-76	157.78	2160
4-22-77	157.58	2060
5-03-78	160.48	3600
4-04-79	160.18	3420
5-17-80	156.62	1680
2-12-81	155.22	1270
4-07-83	161.78	6750

Hydrologic Analyses. The rainfall-runoff models for the Gordons Creek study were formulated with the Hydrologic Engineering Center's computer program HEC-1 using Soil Conservation Service unit hydrograph constants, storage-outflow routing derived by the HEC-2 backwater model, Muskingum routing coefficients, and rainfall from NWS TP40, HYDRO-35 and HMR51. The synthetic unit hydrographs were computed using the HEC-1 model with SCS lags with the curve number method. The hydrologic models provided discharge-frequency relationships adjusted for urbanization using SCS curve numbers with soil class and percent imperviousness and channel improvement. Because of the magnitude and detailed data available for the April 1983 flood, it was reproduced by the HEC-1 model using observed rain and high water marks.

Unit Hydrograph Analysis. Unit graph constants were computed for 17 subareas in the basin for use in the HEC-1 model. The stream lengths and slopes were measured from USGS 1:24000 quadrangle maps. The SCS curve numbers for each area was determined by correlating the Covington County SCS Soil Survey report with data from a telephone conversation with the SCS office in Jackson, Mississippi. The procedure and tables contained in the SCS "National Engineering Handbook, Section 4, Hydrology" (NEH), August 1972 were applied to compute the SCS time lag.

The equation used is:

$$LAG = \frac{(Length)^{0.8} * ((1000/Curve)-9)^{0.7}}{1900 * (\%\ Slope)^{0.5}}$$

Where:

LAG = time to lag in hours

Length = stream distance in feet

Curve = SCS curve number based on soil type, use, and cover

% slope = percent stream slope

The 10-minute unit graph parameters are given in Table 2-B-2 for the rural lag as given by the equation. Urbanization effects were derived using SCS Technical Release No. 55, "Urban Hydrology for Small Watershed". January 1955. The lag reductions were based on area, percent of imperviousness and channel improvement.

TABLE 2-B-2

10-MINUTE SCS UNIT GRAPH DATA

ID	DA	SCS #	STREAM LENGTH	ELEV	STREAM SLOPE	RURAL LAG 1/	% IMP	% CHAN	REDUCTION IMP	REDUCTION CHAN	URBAN LAG 2/
1	1.14	74	8000	160	2.00	1.42	0	0	.00	.00	1.42
2	1.12	77	10400	113	1.09	2.17	10	15	.94	.90	1.84
3	0.71	80	11200	80	.71	2.61	25	80	.84	.55	1.21
4	1.36	77	15600	195	1.25	2.80	10	30	.94	.81	2.13
5	0.20	80	3000	34	1.13	.72	35	80	.79	.55	.31
6	0.54	80	9800	67	.68	2.39	30	80	.82	.55	1.08
7	0.87	80	7800	93	1.19	1.51	15	30	.91	.83	1.14
7A	0.47	80	6400	58	.91	1.47	15	30	.91	.83	1.11
8	0.45	80	5600	56	1.00	1.26	30	80	.82	.55	.57
9	0.39	80	6800	52	.76	1.69	30	80	.82	.55	.76
10	0.17	80	5800	30	.52	1.80	35	80	.79	.55	.78
11	0.83	80	10600	70	.66	2.59	20	80	.88	.55	1.25
12	0.36	80	4900	39	.80	1.27	35	80	.79	.55	.55
13	0.22	80	3800	33	.87	.99	35	80	.79	.55	.43
14	0.52	80	7600	48	.63	2.03	41	80	.76	.55	.85
15	0.26	80	4600	43	.93	1.12	41	80	.76	.55	.47
16	0.40	80	8000	37	.46	2.47	41	80	.76	.55	1.03

1/ Based on given equation
2/ Adjusted by TR 55 for % imperviousness and channel improvement

<u>Rainfall and Loss Analysis</u>. Since the HEC-1 computer model was used to obtain the peak discharges, synthetic rainfall was used to provide the means of determining the various frequency floods. The National Weather Service Technical Paper No. 40 rainfall depths for the 2-year thru 100-year frequencies for the two thru 24 hour durations were used with the NWS HYDRO-35 report 5 through 60 minutes rain values. Normal probability plots were extended to 500-year values using the annual series data. An option in the

HEC-1 model was used where spatial and temporal distributions of point rainfall depths were computed and converted from partial duration to annual series values. A storm on the drainage area at the lower crossing with U.S. Highway 11 was considered to be the size of storm which would provide the typical centering to maximize flows from Tributary No. 1 and the main stem, include the majority of upstream damages, and retain the observed upper basin flood hydrograph which greatly influences the flood hydrographs downstream. The Standard Project Storm was computed by taking half of the probable maximum flood runoff (using 47 inches for the PMP index rain obtained from HMR51). Table 2-B-3 presents the rainfall-depth-frequency used in the HEC-1 model. SCS loss function based on SCS curve number was used to calculate rain losses. SCS curve numbers for each subarea are presented in Table 2-B-2 (a number of 100 would reflect total runoff).

TABLE 2-B-3

UNADJUSTED RAINFALL DURATION IN INCHES

DURATION 1/	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR	500-YR	PMF
5-min	.56	.63	.68	.76	.82	.89	1.11	
15-min	1.20	1.36	1.49	1.68	1.84	1.99	2.36	
60-min	2.30	2.78	3.13	3.64	4.04	4.43	5.31	9.71
2-hr	2.62	3.31	3.76	4.25	4.72	5.23	6.21	13.55
3-hr	2.93	3.72	4.22	4.75	5.30	5.83	6.92	17.15
6-hr	3.49	4.48	5.24	5.99	6.85	7.44	8.78	31.96
12-hr	4.27	5.49	6.33	7.38	8.24	9.15	10.85	38.54
24-hr	4.81	6.40	7.55	8.57	9.70	10.85	13.21	47.00

1/ Reflects partial duration for the 2-, 5-, and 10-year before HEC-1 model corrects the rain by .88, .96, and .99 to obtain annual series rain. Rainfall was corrected to an area of 4.53 square miles, the drainage area above the lower crossing with U.S. Highway 11.

HEC-1 Model Formulation. The HEC-1 model was formulated with Soil Conservation Service unit graph parameters from Table 2-B-2, National Weather Service rainfall from Table 2-B-3, SCS curve numbers from Table 2-B-2 for rain loss rates, Muskigum channel routing on a tributary, and storage-discharge channel routings determined from the HEC-2 backwater runs. By changing the

HEC-2 model for various proposed improvements, the storage-discharge values reflected the hydrologic effects due to the changes in the HEC-2 backwater model. Table 2-B-4 illustrates the steps and procedures that were used in the HEC-1 computer model.

TABLE 2-B-4

HEC-1 MODEL FORMULATION

STEPS	STEPS
1. Compute Area 1 (I-65)	24. Compute Trib Local Area 9
2. Storage Route to 28th Ave	25. Combine Trib Hydrographs
3. Compute Local Area 2	26. Combine Hydrographs
4. Combine Hydrographs	27. Storage Route to Hardy St
5. Storage Route to Hwy 11	28. Compute Local Area 10
6. Compute Local Area 3	29. Combine Hydrographs
7. Combine Hydrographs	30. Compute Trib Local 11
8. Storage Route to Hwy 49	31. Combine Hydrographs
9. Compute Local Area 4	32. Storage Route to Hutchinson
10. Combine Hydrographs	33. Compute Local Area 12
11. Storage Route to Hwy 11	34. Combine Hydrographs
12. Compute Local Area 5	35. Storage Route to Broad St
13. Combine Hydrographs	36. Compute Local Area 13
14. Storage Route to Camp St	37. Combine Hydrographs
15. Compute Local Area 6	38. Storage Route to Green St
16. Combine Hydrographs	39. Compute Local Area 14
17. Compute Trib Area 7	40. Combine Hydrographs
18. Muskingum Route (K=.7,X=.2)	41. Storage Route to Pine St
19. Storage Route to 28th Ave	42. Compute Local Area 15
20. Storage Route to Hwy 49	43. Combine Hydrographs
21. Compute Trib Local Area 8	44. Storage Route to Leaf River
22. Combine Trib Hydrographs	45. Compute Local Area 16
23. Storage Route to Gordons Cr	46. Combine Hydrographs

Model Calibration. The HEC-1 computer model was calibrated with the April 1983 rainfall and high water marks in the basin. The HEC-2 and HEC-1 models were adjusted together to obtain a reasonable flood reproduction by changing rainfall and channel routing as much as possible. Chart 2-B-2 presents the April 1983 flood hydrograph at Broad Street as computed by the calibrated HEC-1 model along with the isohyetal maps. Table 2-B-5 shows the computed April 1983 peak discharges for locations on Gordons Creek. The peak discharge at Broad Street was measured by U.S. Geololical Survey.

TABLE 2-B-5
APRIL 1983 FLOOD PEAKS

LOCATION	DA	DISCHARGE
Mouth	10.01	5610
Pine St	9.61	6850
Green St	9.35	6870
Broad St	8.83	6750
Hutchinson St	8.61	6770
Below Trib #1	8.25	6720
Hardy St	7.42	5710
Below Trib #2	7.25	5680
Camp St	5.07	4070
Hwy 11	4.53	3900
Hwy 49	4.33	4350
Hwy 11	2.97	3080
28th Ave	2.26	2330
I-59	1.14	1190

Regional Frequency Analysis. Several regional frequency studies of peak discharges were compared to the adopted HEC-1 model discharges. The U.S. Geological Survey frequency analysis completed in 1976 for the whole state of Mississippi is referred to as the Mississippi Streams equations (MS). A set of equations based on drainage area, stream length, and stream slope at .1 and .85 of the stream length were developed for the 2-year thru 100-year peaks. These Mississippi Streams rural peaks were then adjusted by the Sauer procedures as presented in the USGS "Preliminary Flood-Frequency Relations for

Urban Streams, Metropolitan Atlanta, Georgia" WRI 77-57 dated 1978. The second study used for comparison purposes is an unpublished Corps regional analysis of the upper Tombigbee and Pascagoula Rivers Basins (TP). The mean annual flood, Q in cfs, are defined for rural conditions on Gordons Creek: $\log(Q) = 2.411 + .626\log(A)$, where A = drainage area in square miles, standard deviation (S) = .32, and skew of 0. Log Pearson Type III frequency curves for rural conditions were computed using these parameters. The Tombigbee-Pascagoula (TP) rural peaks were urbanized by the Sauer method according to percent sewers serving area and imperviousness and the rainfall intensity ratios applicable to the Hattiesburg area. A third comparison with the HEC-1 peak discharges was done using the peaks from the "Detailed Project Report on Gordons Creek" dated August 1968. Comparisons are provided in Table 2-B-6. See Charts 2-B-3 through 2-B-6 for a plot of the Table 2-B-6 data.

TABLE 2-B-6

HEC-1 COMPARISON WITH REGIONAL STUDIES PEAK DISCHARGES

LOCATION	DA	STREAM LENGTH	STREAM SLOPE	TYPE	PEAKS IN CFS 2-YR	10-YR	25-YR	100-YR
Broad St	8.83	7.24	23.59	HEC	2270	4390	5000	6170
I=30,S=20				MS	2284	4155	5179	6791
				TP	1913	3892	5103	7220
				DPR	2659	4150	4852	6124
Hardy St	8.25	6.29	24.29	HEC	2240	4330	4940	6120
I=25,S=20				MS	2144	3933	4920	6482
				TP	1737	3596	4941	6769
				DPR	2805	4353	5076	6407
Camp St	5.07	6.04	25.60	HEC	1[illegible]40	2820	3280	4110
I=25,S=20				MS	1396	2531	3159	4151
				TP	1253	2531	3159	4151
				DPR	1684	2616	3058	3849
Hwy 11	2.97	4.34	33.51	HEC	910	1940	2260	2840
I=15,S=20				MS	902	1654	2067	2714
				TP	764	1678	2261	3287
				DPR	1193	1828	2131	2677

I = % Imperviousness
S = % Area Serviced by Sewers
HEC = HEC-1 and HEC-2 models
MS = Urbanized Mississippi Streams equations
TP = Mobile District of the Corps regional equation for the upper Tombigbee and Pascagoula Rivers.
DPR = Detailed Project Report on lower Gordons Creek

Hydrologic Model Results. Peak discharges computed by the HEC-1 model reflect present condition hydrologic effects and account for existing improvements. The HEC-2 backwater storage-discharge tables were used for stream routing purposes for Gordons Creek and its large tributary near the county hospital. Table 2-B-7 includes the location and present condition peak discharges. Chart 2-B-7 shows the 100-year flood hydrographs at Highway 49 and below Trib #2 in Kamper Park. The discharge-stage-frequency curves are in Section C of this Appendix. The peak discharge-drainage-frequency curves are in Chart 2-B-8.

TABLE 2-B-7

PRESENT CONDITION PEAK DISCHARGES IN CFS

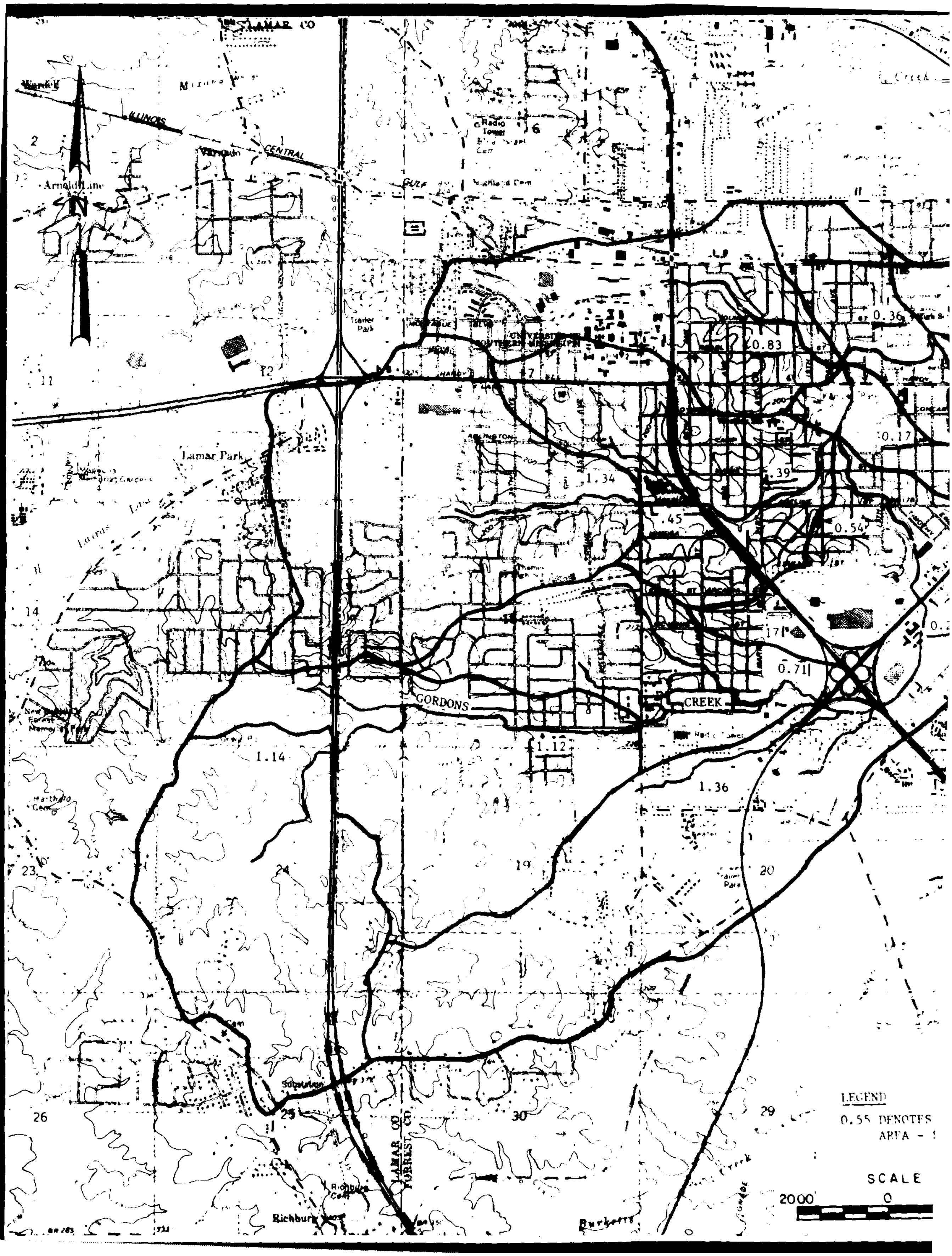
LOCATION	DA	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR	500-YR	SPF
Main Creek									
Mouth	10.01	2390	3920	4630	5030	5180	5450	7040	10150
Pine St	9.61	2370	3770	4560	5170	5840	6370	7510	10970
Green St	9.35	2340	3730	4610	5130	5780	6310	7510	10930
Broad St	8.83	2270	3640	4390	5000	5630	6170	7300	10390
Hutch. St	8.61	2260	3620	4370	4970	5610	6140	7270	10260
Trib 1	8.25	2240	3590	4330	4940	5620	6120	7330	10170
Hardy St	7.42	2070	3350	4060	4680	5310	5810	6900	9310
Trib 2	7.25	2050	3330	4040	4720	5350	5850	6900	9270
Camp St	5.07	1440	2320	2820	3280	3730	4110	4930	6790
Hwy 11	4.53	1340	2200	2710	3170	3590	3960	4760	6500
Hwy 49	4.33	1310	2190	2770	3250	3690	4140	5040	6720
Hwy 11	2.97	910	1530	1940	2260	2530	2840	3410	4490
28th Ave	2.26	710	1240	1570	1890	2200	2480	2960	3870
I-59	1.14	370	660	860	1060	1240	1420	1790	2350
Coincidental at									
Trib 2	7.25	1490	2440	3120	3730	4290	4770	5820	8210
Trib 2									
Mouth	2.18	860	1390	1670	1980	2200	2380	2770	3320
Hwy 49	1.79	680	1100	1300	1530	1730	1900	2290	2920
28th Ave	1.34	600	960	1200	1430	1640	1850	2280	2810

Gordons Creek Starting Water Surfaces. In order to compute the backwater profiles on Gordons Creek, the starting water levels at the confluence of Gordons Creek and Leaf River were estimated and used in the HEC-2 model. The flood hydrographs and stages for the Leaf River reflect conditions after the proposed Leaf and Bowie project is installed. These coincident stages were very close to those values used in the Gordons Creek Detailed Project Report of 1976 and are shown in Table 2-B-8. Coincident Leaf River water surface corresponds to the elevation at the mouth of Gordons Creek when Gordons Creek peaks. Leaf River peak water surface is the maximum level that a given frequency flood on the Leaf River attains at the mouth of Gordons Creek and would be the controlling water surface elevation for the lower reach of Gordons Creek. Leaf River peak stage were obtained from the 1983 Leaf-Bowie Detailed Project Report.

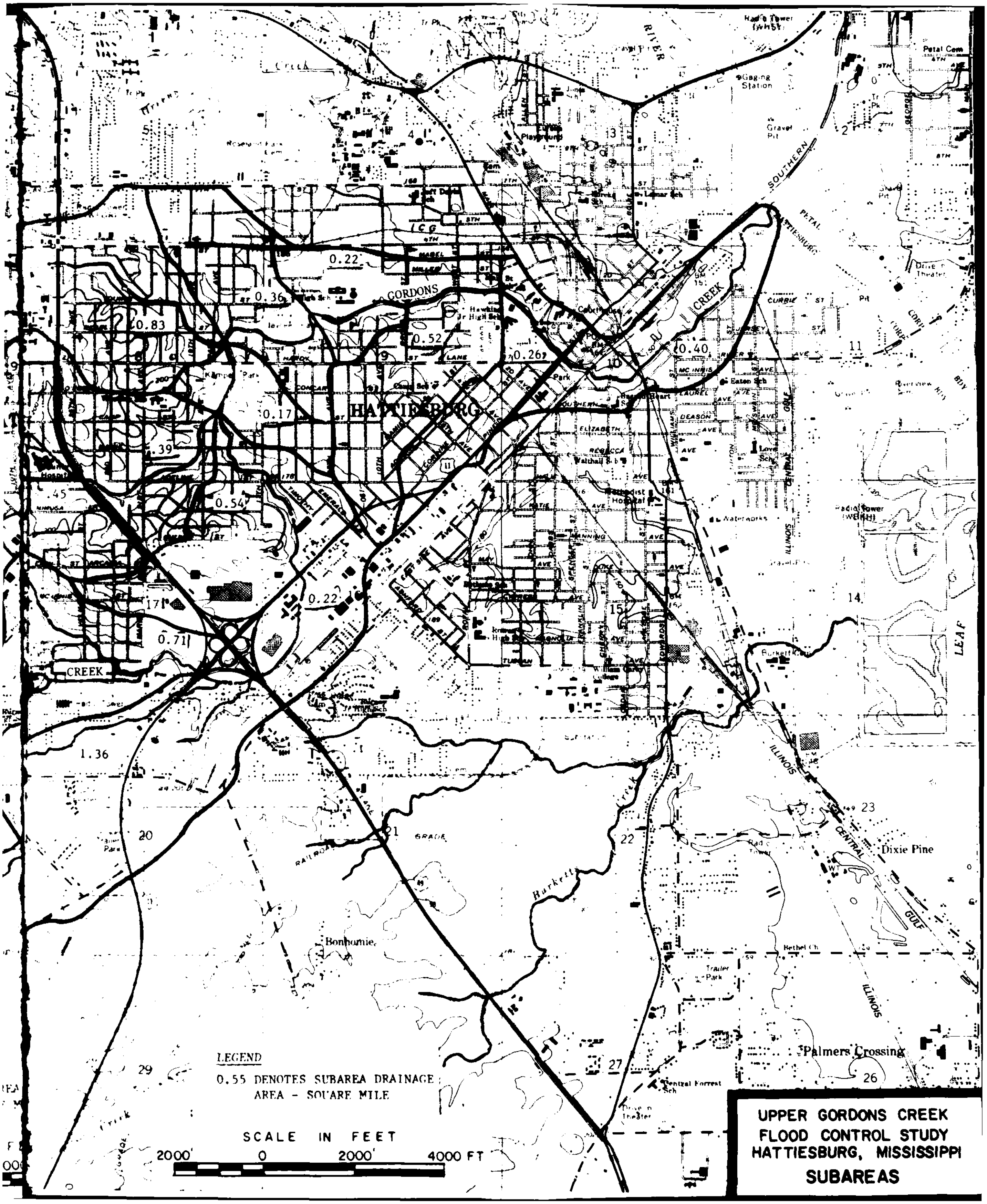
TABLE 2-B-8

STARTING WATER SURFACES IN FEET NGVD

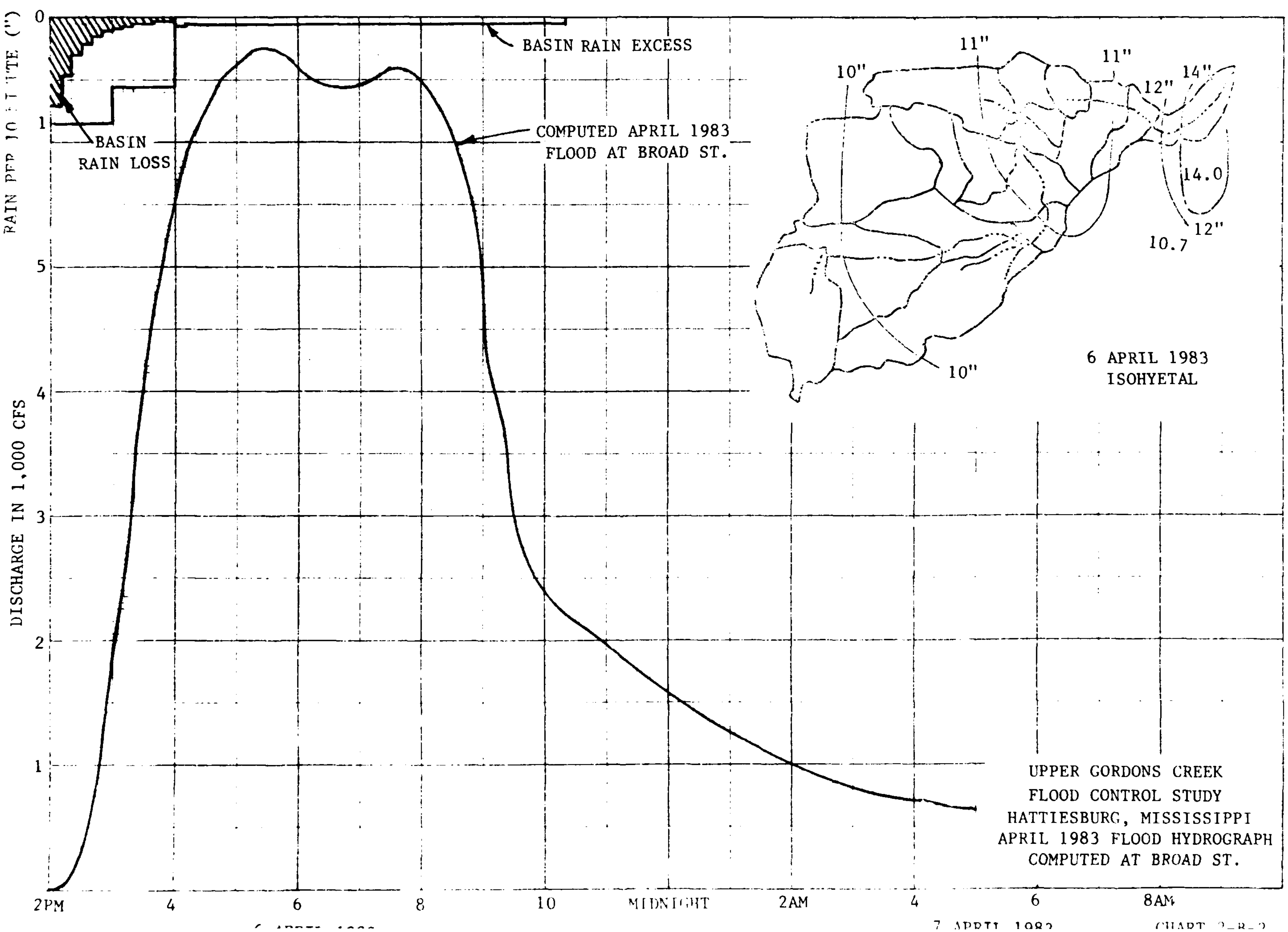
FREQUENCY	COINCIDENT LEAF	LEAF PEAK
2-YR	137.9	137.9
5-YR	138.8	142.0
10-YR	140.1	144.1
25-YR	141.5	146.5
50-YR	142.8	148.2
100-YR	143.8	149.7
500-YR		154.3
SPF	148.0	

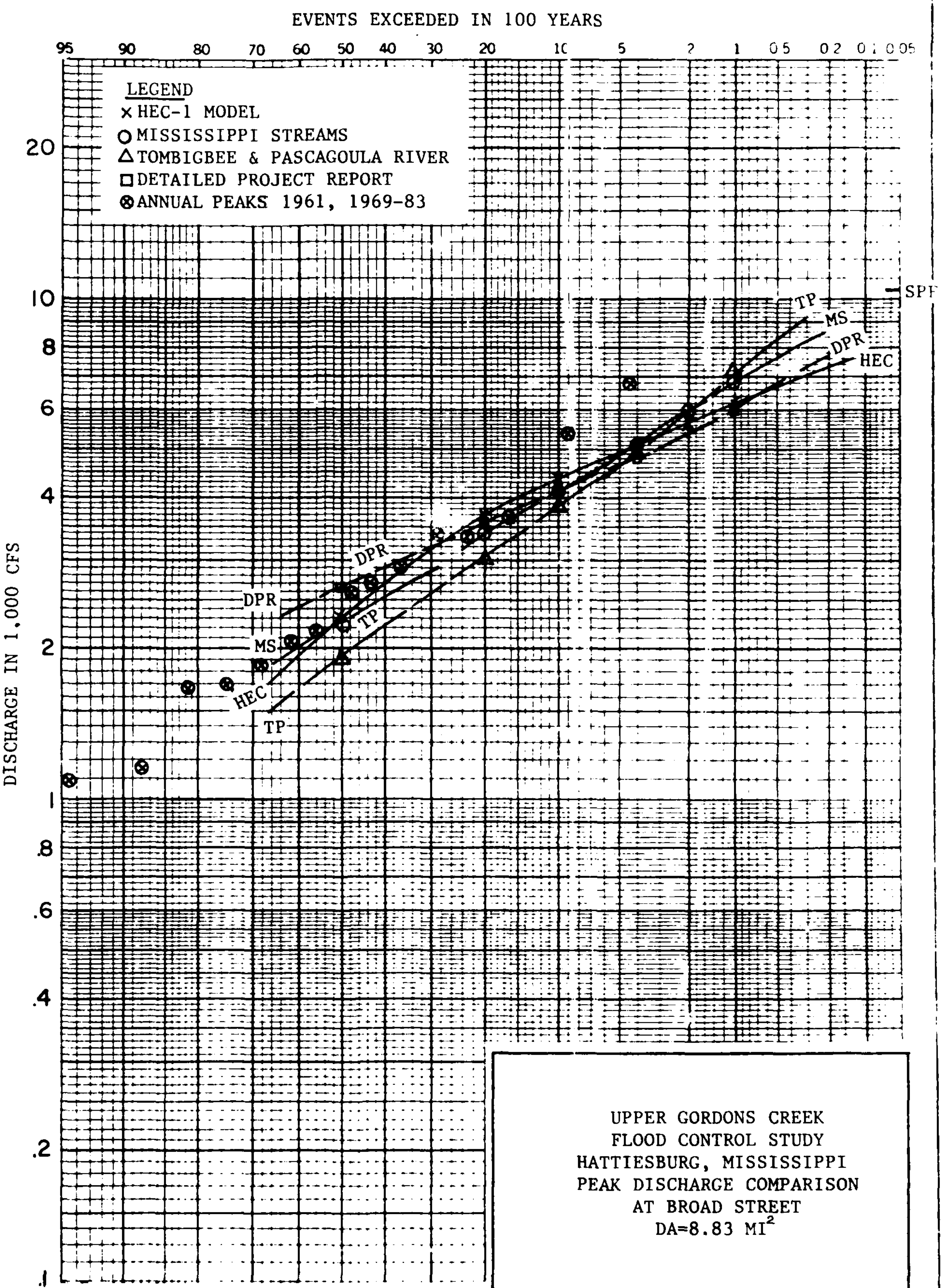


LAMAR CO
ILLINOIS
CENTRAL
GULF
Arnold Line
Lamar Park
Radio Tower
2
6
11
12
7
14
0.36
0.83
0.17
.39
1.34
.45
0.54
17
0.71
GORDONS
CREEK
1.14
1.12
1.36
23
24
19
20
26
25
30
29
LAMAR CO
FORREST
Richburg
LEGEND
0.55 DENOTES
AREA -
SCALE
2000
0



UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
SUBAREAS
LEGEND
0.55 DENOTES SUBAREA DRAINAGE AREA - SQUARE MILE
SCALE IN FEET
2000' 0 2000' 4000 FT
HATTIESBURG
GORDONS
CREEK
CREEK
LEAF
RIVER
SOUTHERN
ILLINOIS
CENTRAL
GULF
Burkett
Bonhomie
Dixie Pine
Palmers Crossing
Gaging Station
Gravel Pit
Waterworks
0.22
0.36
0.83
0.52
0.26
0.40
0.17
.39
.45
0.54
0.22
0.71
1.36


BASIN RAIN EXCESS
BASIN RAIN LOSS
COMPUTED APRIL 1983 FLOOD AT BROAD ST.
RAIN PER 10 MINUTE (")
DISCHARGE IN 1,000 CFS
0
1
5
4
3
2
1
2PM
4
6
8
10
MIDNIGHT
2AM
4
6
8AM
10"
11"
11"
12"
14"
14.0
12"
10.7
10"
6 APRIL 1983
ISOHYETAL
UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
APRIL 1983 FLOOD HYDROGRAPH
COMPUTED AT BROAD ST.



UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
PEAK DISCHARGE COMPARISON
AT BROAD STREET
DA=8.83 MI^2

CHART 2-B-3

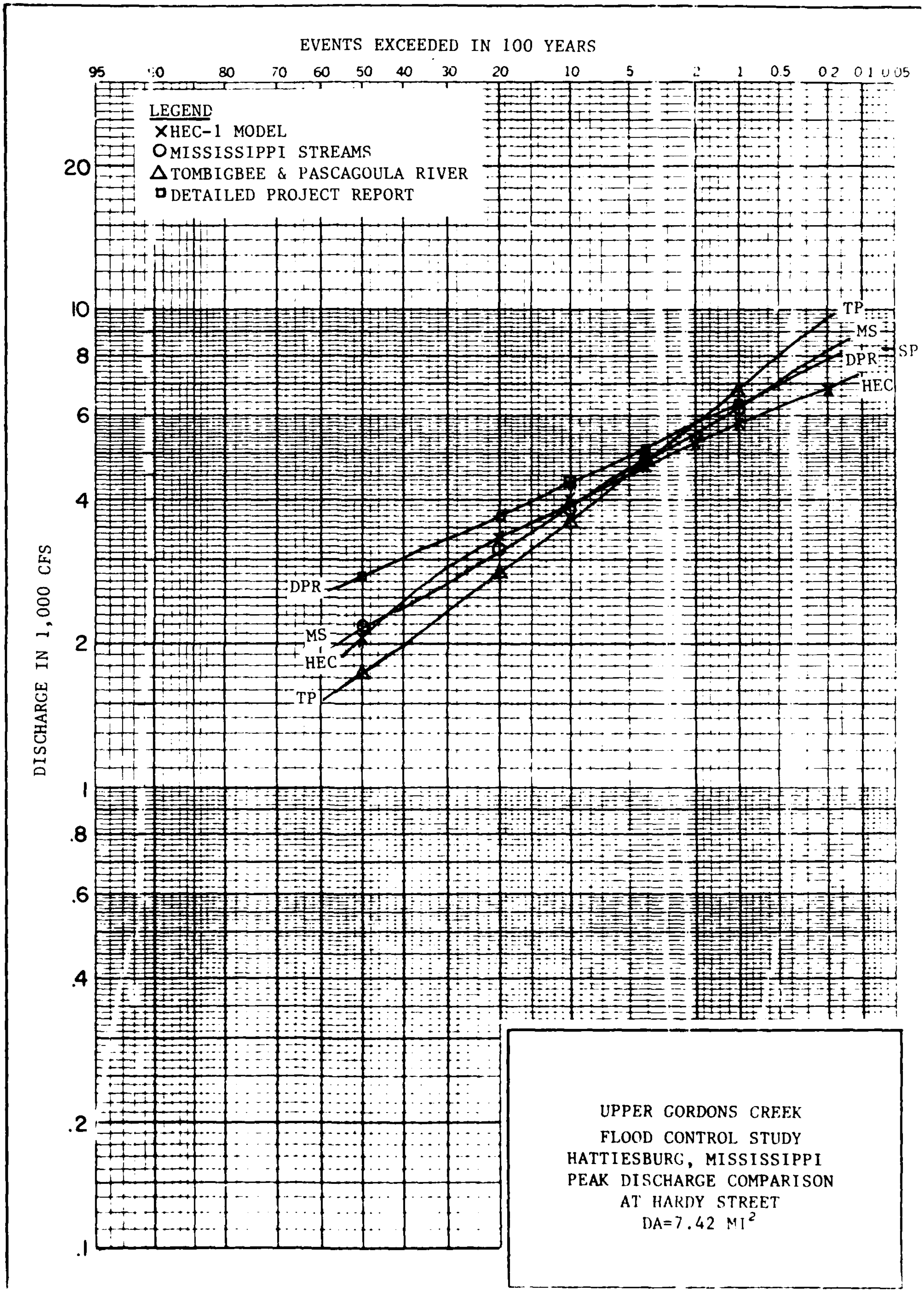
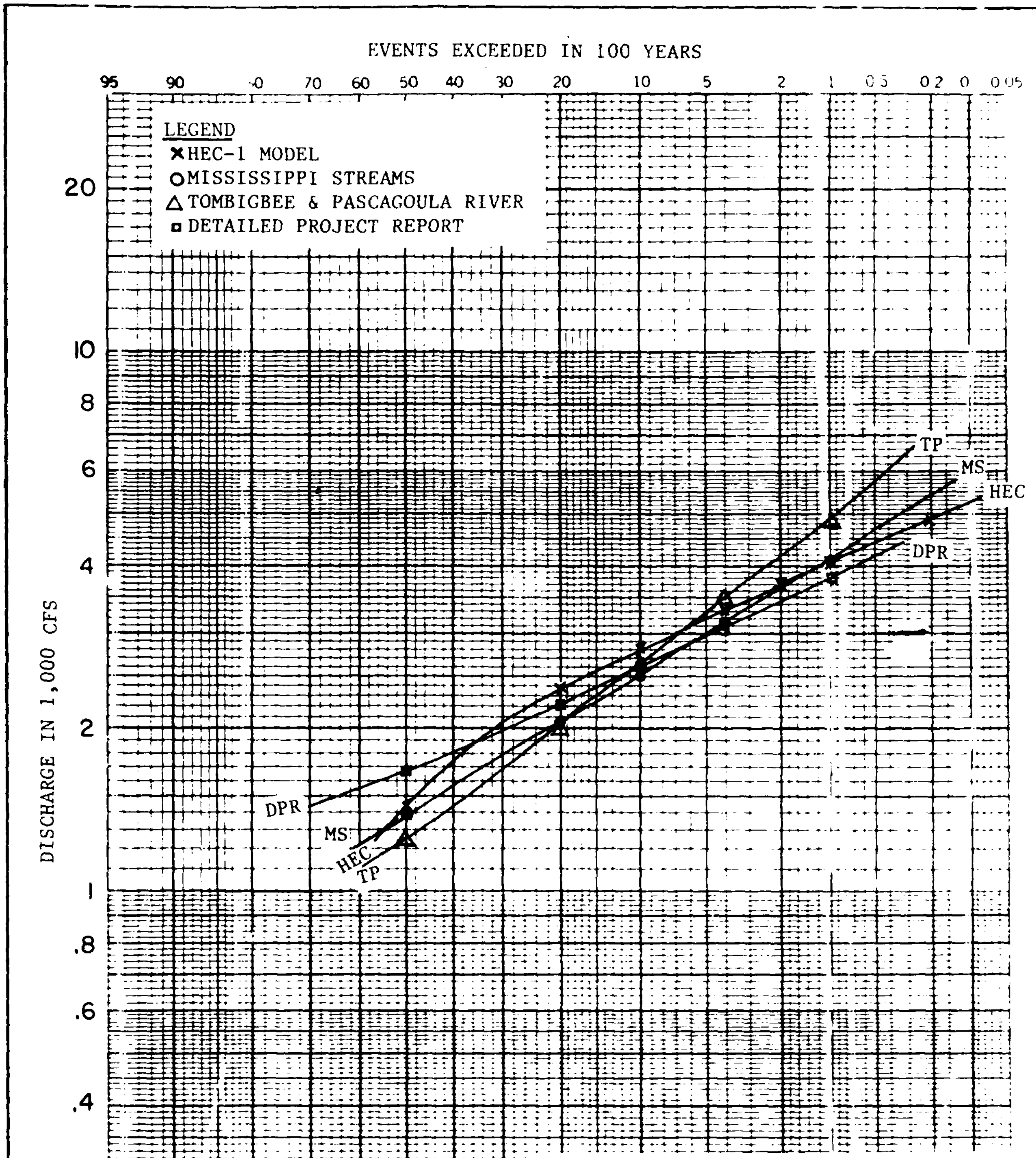
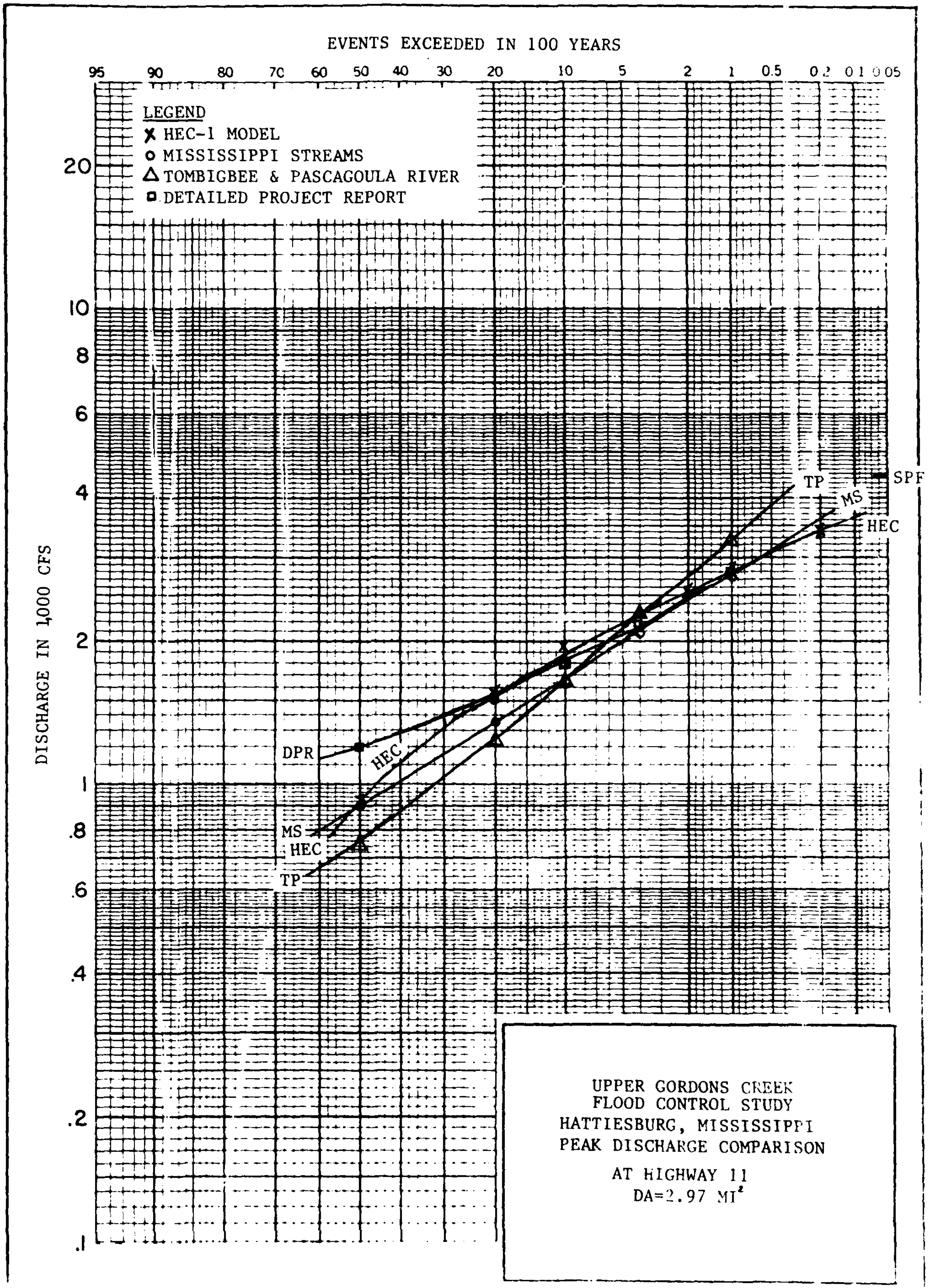

EVENTS EXCEEDED IN 100 YEARS
LEGEND
HEC-1 MODEL
MISSISSIPPI STREAMS
TOMBIGBEE & PASCAGOULA RIVER
DETAILED PROJECT REPORT
DISCHARGE IN 1,000 CFS
DPR
MS
HEC
TP
SP
UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
PEAK DISCHARGE COMPARISON
AT HARDY STREET
DA=7.42 MI²

CHART 2-B-4



UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
PEAK DISCHARGE COMPARISON
AT CAMP STREET
DA=5.07 MI^2

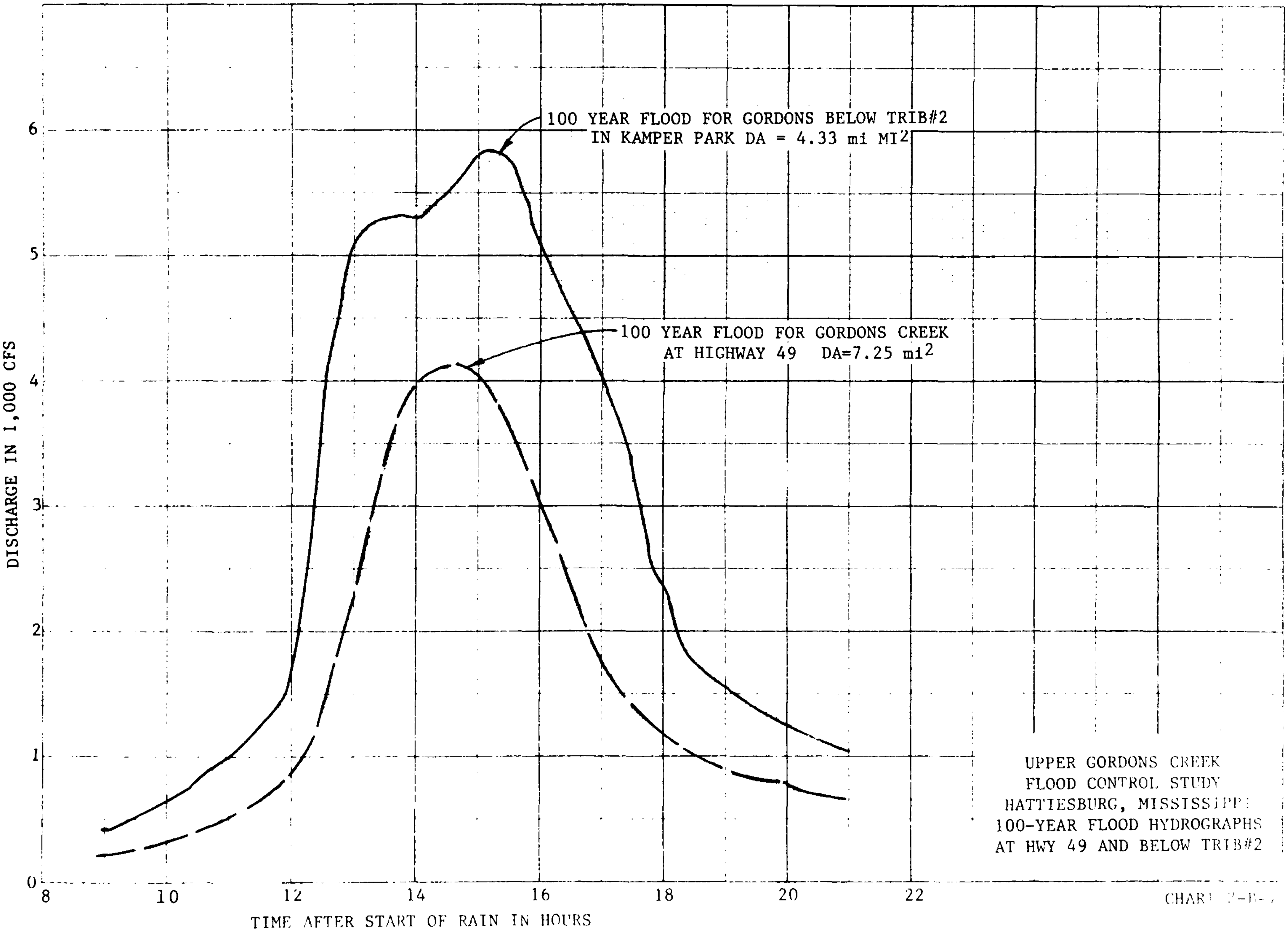
CHART 2-B-5



EVENTS EXCEEDED IN 100 YEARS
95
90
80
70
60
50
40
30
20
10
5
2
1
0.5
0.2
0.1
0.05
LEGEND
HEC-1 MODEL
MISSISSIPPI STREAMS
TOMBIGBEE & PASCAGOULA RIVER
DETAILED PROJECT REPORT
DISCHARGE IN 1,000 CFS
20
10
8
6
4
2
1
.8
.6
.4
.2
.1
TP
MS
HEC
SPF
DPR
HEC
MS
HEC
TP
UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
PEAK DISCHARGE COMPARISON
AT HIGHWAY 11
DA=2.97 MI²

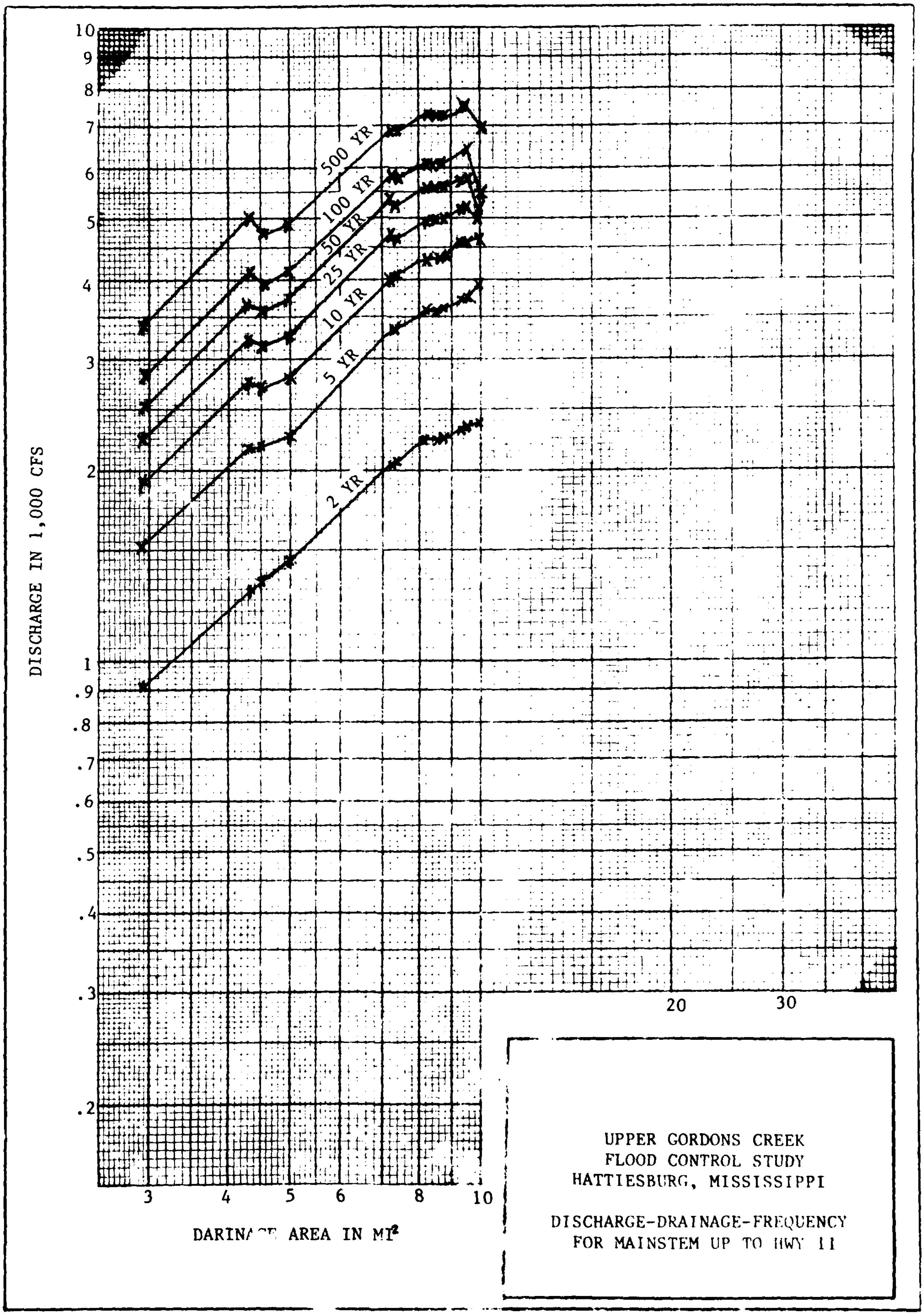
CHART 2-B-6

12 X 20 TO THE INCH 359-21



UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
100-YEAR FLOOD HYDROGRAPHS
AT HWY 49 AND BELOW TRIB#2

CHART



10
9
8
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.9
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500 YR
100 YR
50 YR
25 YR
10 YR
5 YR
2 YR
20
30
3
4
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6
8
10
DISCHARGE IN 1,000 CFS
DARINA᷊E AREA IN MI²
UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
DISCHARGE-DRAINAGE-FREQUENCY
FOR MAINSTEM UP TO HWY 11

CHART 2-B-8

SECTION C

HYDRAULIC INVESTIGATIONS

Data Base. Geographic data for use in the study of Gordons Creek was taken from channel cross sections surveyed by Michael Baker, Incorporated, in connection with the flood insurance study printed in 1982. These sections were supplemented by City of Hattiesburg topographic mapping with two-foot contour intervals. This mapping was reproduced for use as base mapping in this report. Additional cross-section data was obtained by field surveys in the summer of 1982.

Sediment data were collected by Corps personnel in January 1983. A total of 25 bed and bank samples were taken on both Gordons Creek and the tributary extending from Kamper Park alongside the Forrest General Hospital. A piston operated bed material hand sampler was used to sample material to depths of 12 inches or less. Typically, the banks are soft to firm sandy clay silts. The natural banks appear to be stable with slopes of approximately one vertical on one horizontal. In some areas, the clay is exposed and appears to be quite resistant to erosion. In other areas, sand and gravel sediments overlay the clay with thicknesses varying from a few inches to two feet. More information concerning the geology and soils of the basin are contained in the Geology and Soils section of this Appendix.

The U.S. Geological Survey has three crest-stage gages along Gordons Creek. However, of the three sites, only the Broad Street site has an established rating curve. After examination of this data, it was determined that the curve had not been adjusted to account for the effect of the existing Gordons Creek project. High water marks were surveyed after the April 1983 flood, thus providing a flood profile for that event.

Several field inspections were made to observe geomorphological characteristics, manmade structures, and channel and basin stability appearances.

DESIGN PROCEDURE

Analyses of proposed improvements were made using a HEC-2 standard step backwater math model. The model was calibrated as near as possible to observed field data and modified mathematically to simulate channel modifications.

The Gordons Creek HEC-2 model extended from the creek's confluence with Leaf River upstream approximately 7.7 miles, or to just downstream of the Interstate 59 crossing. The HEC-2 model of the Hospital tributary extended from its confluence with Gordons Creek upstream approximately 1.8 miles, or to just above the 34th Avenue crossing of the stream.

MODEL CALIBRATION

Contraction and expansion coefficients of 0.3 and 0.5, respectively, were used for calibration of the existing model as well as for every alternative evaluated.

Channel "n" values typically ranged from 0.015 in concrete lined reaches to 0.05 in other areas. For the most part, the entire length of both Gordons Creek and the Hospital Tributary have been at sometime relocated or channelized, requiring the use of relatively low channel "n" values for existing conditions. Generally overbank "n" values ranged from 0.1 to 0.2 to reflect the wide range of conditions encountered in the field.

Both the special bridge and normal bridge routines were used in the HEC-2 model to simulate all bridges and culverts in the study area. The completed model consisted of approximately 209 sections with over 190 sections

associated with the 34 bridges modeled. No debris blockage was assumed at bridges.

Starting water surface elevations were chosen from a rating curve on the Leaf River. Coincidental discharges on the Leaf River were determined for peak discharges on Gordons Creek. These coincidental discharges were used to determine the starting water surface elevations. These elevations are shown in Table 2-B-8, Section B of this Appendix.

The April 1983 flood profile was used to calibrate the Model. The model was calibrated to within 0.5 feet of the April 1983 flood for the majority of the creek. The rating curve at Broad Street was not applicable since it does not reflect the channel modifications performed by the earlier Federal project.

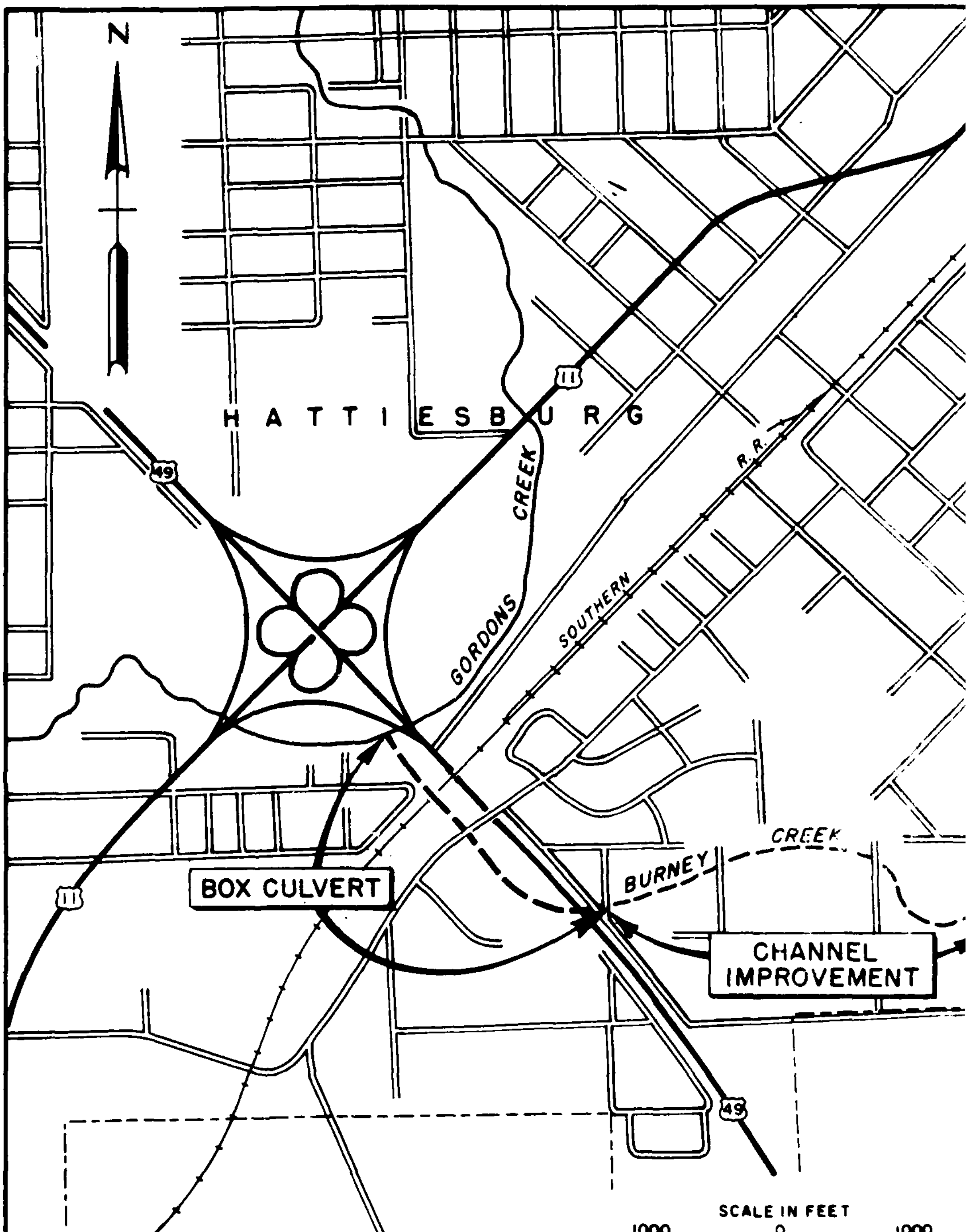
DESIGN OF ALTERNATIVES

Existing Conditions. Charts No. 2-C-1 through 2-C-5 present the project location and extent of the study area along with flood profiles for existing conditions for the 2-,5-,10-,25-,50-,100-, and 500-year frequency floods and the Standard Project Flood. Development of the discharges for these floods is described in the Hydrologic Section of this Appendix and the discharges are presented in Charts No. 2-C-6 through 2-C-10.

Project Conditions. Flood profiles were computed for every alternative examined for the 2-,5-,10-,25-,50-,100-, and 500-year frequency floods and the Standard Project Flood. For channel alternatives, the channel improvement (CHIMP) option of the HEC-2 model was used to simulate the modification of cross section data. Mannings "n" values were not changed from those used for existing conditions.

Diversion of Flood Flows. Diversion of flood waters was investigated to avoid induced damages on the Lower Gordons Creek project due to increased stages resulting from increased discharges. Several possible schemes were investigated initially. As a result of these early investigations, two plans were advanced to the plan formulation stage. Both plans would divert a maximum discharge of 2000 CFS from Gordons Creek in the area of the U.S. Highway 49 by-pass, or at approximately station 260+00 on Gordons Creek.

Plan 13. Plan 13 would divert flood waters from Gordons Creek to a tributary of Burketts Creek named Burney Creek. Flood waters would be diverted via a reinforced concrete box culvert. The box culvert would consist of two 10 x 10-foot barrels. The culvert would be approximately 2200 feet long, requiring in one reach, a cut of over 30 feet. The culvert layout is shown on Figure 2-C-1. The culvert would end on the downstream side of a street bridge on the east side of U.S. Highway 49. At this point, the culvert invert would be approximately eight feet below the existing invert of Burney Creek. From this point downstream, approximately 3300 feet of concrete lined channel would be constructed. This work would extend to just downstream of Dossett Avenue. The channel would have a 20 foot bottom width with side slopes of one vertical on three horizontal. Concrete would extend vertically an average of five feet above the invert of the channel. The Channel improvement was necessary in view of the fact that discharges on Burney Creek would increase 1400% over existing conditions discharges during times when the diversion is functioning. Although a detailed channel stability study was not performed, the pre-project and post-project sediment transport rates were compared. The Colby sediment transport relationship was used for this analysis. The results are shown in Table 2-C-1.



UPPER GORDONS CREEK
SHORT DIVERSION
PLAN 13

FIGURE NO. 2-C-

TABLE 2-C-1

Burney Creek Sediment Discharge

Condition	2-Year Discharge CFS	Average Channel Velocity FPS	Channel Bottom Width Ft.	Sediment Discharge Tons/Day
Existing Conditions	70	3.5	5	15
Project Conditions*	1,000	9.0	20	210

*Without Concrete Lining

As shown in Table 2-C-1, the difference in sediment transport rates is significant, thus the potential for channel stability problems is great. The volumes shown are potential volumes and the amounts are not as significant as the magnitude of the difference between existing and project conditions. In view of this evidence it was determined necessary to protect the channel. Drop structures and/or flood water retention were not considered practical.

Design efforts were held to a minimum until the economic effectiveness could be determined, and the costs of only the easily identifiable, major components were determined. These costs are shown on Table 2-E-1 in Section E of this Appendix, and consist mainly of clearing, grubbing, excavation, concrete, relocations, backfill and grassing. The cost estimate does not include provisions for the following items:

a. Lands, easements and rights of way;
b. The construction of a diversion structure in Gordons Creek (This structure should be designed to divert sediment as close as practical in proportion to discharge);

c. Channel modification of Burketts Creek or erosion control structures associated with the creek downstream of the concrete lining;

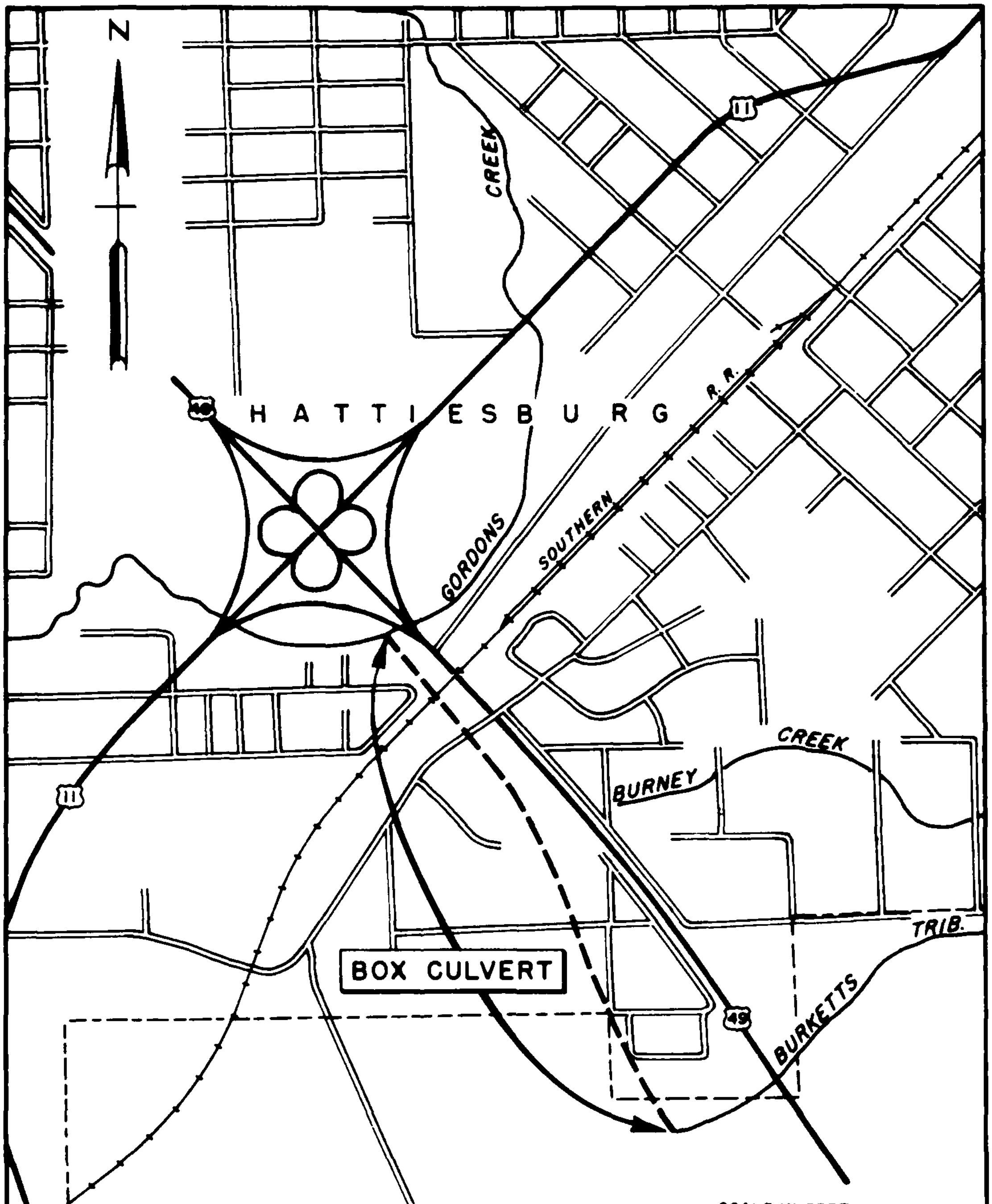
d. Costs associated with induced flood damages in the Burney and Burketts Creek Basin;

e. Costs for special measures associated with excavation at the upstream end of the diversion; (i.e. sheet pile driven to protect existing structures during excavation and construction);

f. Costs associated with surface or ground water control during construction;

g. Operation and maintenance costs on the completed structure.

Plan 14. The alignment for Plan 14 is shown on Figure 2-C-2. The upstream 1500 feet of this structure follows closely the alignment used in the examination of Plan 13. The culvert geometry is identical for both plans. However, in this plan the culvert is approximately twice as long. This plan examined a culvert 4400 feet long. It became apparent in the early stages of examination that this scheme would not be economically feasible. Table 2-E-2 in Section E of this Appendix contains a partial cost estimate for construction of this plan. This plan is more costly than the previously described plan and the benefits on Gordons Creek would be the same as with Plan 13. Therefore, the design was carried no further. As was the case with Plan 13, the estimated costs do not include many of the same aforementioned items associated with Plan 13 that would tend to further increase costs.



UPPER GORDONS CREEK
LONG DIVERSION
PLAN 14

FIGURE NO. 2-C-2

Bridge Modification. An investigation was made of bridge modifications to reduce flood stages. Bridge crossings on the main creek at U.S. Highway 49, U.S. Highway 11 (upstream of Highway 49), and U.S. Highway 11 (downstream) were enlarged and an economic analysis was made of the change in damages. The work could not be justified.

Channel Modification. Several channel modifications were considered as alternative plans for reduction of flood stages. The Hydraulic investigations indicate that any channel modifications upstream of the existing project on Gordons Creek will tend to increase stages in the existing project area. With diversion not economically feasible, the increased stages are apparently unavoidable. Measures investigated to mitigate the induced damages along the existing project are discussed in Appendix 5.

The following alternative plans were simulated in the HEC-2 model to determine the extent of justifiable improvements.

Plan 21. Plan 21 is basically an extension of the existing channel project on Gordons Creek. The existing 40-foot bottom width channel that currently terminates at Broad Street, would be extended upstream approximately one mile to the Hardy Street crossing. At this point the improved channel ties to the existing concrete channel that extends through Kamper Park. The improved channel invert would be the same as the existing channel invert. Side slopes would be 1 vertical on 3 horizontal.

Plan 22. Plan 22 is an extension of Plan 21. The 40-foot bottom width channel extends from the end of the concrete channel through Kamper Park to U.S. Highway 49, an additional 1.3 miles. The improved channel invert would be the same as the existing channel invert. Side slopes would be 1 vertical on 3 horizontal.

Plan 23. Plan 23 is the same as Plan 22 with an additional 1.2 miles of channel modification extending from U.S. Highway 49 to South 28th Avenue. Bottom width, side slopes and assumptions pertaining to invert elevations are the same as with Plans 21 and 22.

Plan 24. Plan 24 is the same as Plan 23 downstream of South 28th Avenue. This plan includes an additional increment of channel modification upstream of South 28th Avenue. From South 28th Avenue upstream to the Lincoln Road crossing, in the vicinity of South 40th Avenue, a 30-foot bottom width channel was examined. Assumptions pertaining to side slopes and improved channel inverts are the same as was with the previous plans. The additional channel work is 1.1 miles long bringing the total project length to 4.6 miles.

Plan 25. Plan 25 combines Plan 24 with work on a tributary to Gordons Creek. The tributary, referred to as the Hospital Tributary, has its confluence with Gordons Creek in Kamper Park. Proposed work on the tributary consists of a 30-foot bottom width channel extending from an existing concrete lined portion of the tributary in Kamper Park upstream 0.6 miles to U.S. Highway 49.

Plan 26. Plan 26 contains all the elements contained in Plan 25 with the addition of a 20-foot bottom width channel on the Hospital Tributary upstream of U.S. Highway 49 continuing to 34th Avenue. This additional work on the Hospital Tributary brings the total project work on both streams to 6.3 miles.

Final Plan Formulation. After evaluation of the initial plans, diversion of flows on the main stem and work on the Hospital Tributary were shown to not be cost effective. It was determined that some plan or combination of plans on the main stem were economically viable. The following plans were carried to the final plan development stage.

Plan 24A. Plan 24A consists of a 40-foot bottom width channel from Broad Street to Hardy Street which is the downstream limit of the existing concrete channel through Kamper Park. From the upstream end of the concrete reach to Lincoln Road at the intersection of South 40th Avenue, a 30-foot bottom width channel was examined.

Plan 24B. Plan 24B is the same as Plan 24A except that in the reach above South 28th Avenue, the bottom width has been reduced from 30 feet to 20 feet. Assumptions concerning side slopes, channel slopes and alignment are the same for this plan as was for all channel plans considered.

Plan 27. Plan 27 is the same as Plan 24B except that in the reach from Kamper Park to U.S. Highway 11 (Broadway Drive), no channel enlargement would be performed. Instead, in this reach eight structures would be removed from the flood plain. For the channel enlargement portion of the plan, assumptions concerning side slopes, channel slopes and alignment are the same as for Plan 24B.

Plan 28. Plan 28 is the same as Plan 24B except that in the reach from Kamper Park to U.S. Highway 49, no channel enlargement would be performed. In this reach eight structures would be removed from the flood plain in a similar manner as Plan 27. For the channel enlargement portion of the plan, assumptions concerning side slopes, channel slopes and alignment are the same as for Plan 24B.

NED PLAN

General. The NED plan is Plan 27. The NED plan includes the construction of a 40-foot bottom width channel from the upstream end of the existing project at Broad Street to Hardy Street where it connects with an existing concrete channel, a distance of approximately 5,700 feet. In the vicinity of Brooklane Street, nine structures will be removed from the flood plain. From the bridge at U.S. Highway 11 (Broadway Drive), the channel enlargement project continues upstream with a 30-foot bottom width channel. The 30-foot bottom width channel extends approximately 8,700 feet to South 28th Avenue where it terminates at a new culvert that replaces the two existing bridges at South 28th Avenue and Lincoln Road. From the upstream end of the new culvert, the improved channel bottom width is reduced to 20 feet. This channel continues approximately 5,700 feet, to the project limits at the intersection of Lincoln Road and South 40th Avenue. Typical channel sections are shown on Plate 2-C-34. Additionally, a 15-foot easement will be provided on both banks where channel work is done. This easement will be for possible bank failures and will not be cleared during construction.

The channel modification work consists basically of channel widening and flattening of the existing side slopes. All improved channel side slopes will be constructed to one vertical on three horizontal and all work will be accomplished from within the top of the constructed banks. The new alignment will follow the existing alignment as closely as possible. There will be slight shifts in order to avoid as much as possible, major impacts on existing structures. These structures include houses, bridges, utilities, existing concrete, and riprap protected banks. There are two minor realignments planned, one at the intersection of South 28th Avenue and Lincoln Road, and the other at the intersection of South 34th Avenue and Lincoln Road. These realingments will require the construction of two new bridges at the sites. Details on these rea gnments are shown on Chart No. 2-C-11. The improved channel invert will closely follow the existing channel invert, thus maintaining the present channel slope. Bridge protection in the form of riprap will be placed at all bridges and culvert crossings where channel work is done.

Channel Stability. In order to determine the stability of the proposed project, a sediment transport analysis was performed on Gordons Creek. During initial site investigations, 25 bed and bank samples were collected. These data along with data from the HEC-2 model (channel velocities, top widths, and channel conveyance areas) were used in the Colby sediment transport relation to simulate potential sediment transport tendencies along Gordons Creek. Table 2-C-2 shows with and without project channel velocities. This analysis resulted in sediment rating curves at various points along the stream. Since Gordons Creek has no recording stream gage, and thus no flow duration data, these sediment rating curves were combined with the frequency hydrographs in order to determine the relative magnitude of the differences in transport capacity between project and existing conditions at specific sites. These analyses resulted in the identification of degradation/aggradation trends for the entire stream.

The results of the study indicated that under natural conditions there were no great differences in transport capacity from reach to reach. Under project conditions, the general tendencies are the same, only the potential transport rates have increased approximately 40 percent.

Even though analyses have shown the transport capacity is increased, it is anticipated that the proposed channel will have an acceptable level of stability and the project will function as designed with normal operation and maintenance procedures. This is based on the fact that the stream is intermittent, floods are of short duration and there is evidence of clay in the stream bed. In view of the stream's intermittent nature, it is anticipated that a good stand of vegetation will be established and maintained on the channel banks. It should be emphasized that side slopes of one vertical on three horizontal are essential for stability objectives and should not be changed without providing riprap protection.

Table 2-C-2

Channel Velocities (fps)

Location	Flood Frequency							
	2-Year		10-Year		50-Year		100-Year	
	Nat.	Proj.	Nat.	Proj.	Nat.	Proj.	Nat.	Proj.
Broad St	4.8	4.8	5.3	5.4	5.9	6.0	6.1	6.2
Hutchinson St	3.7	7.0	4.6	6.7	5.0	7.2	5.4	7.4
Sta. 16368	3.9	5.0	4.4	5.6	4.2	6.0	4.2	6.1
Hardy St	3.7	10.5	4.9	11.9	5.8	11.8	6.2	11.5
Mamie St	4.0	4.0	5.3	5.6	6.2	6.2	6.4	6.3
Adeline St	4.6	4.6	5.1	5.0	4.6	4.6	4.5	4.5
Sta. 22968	4.1	4.2	5.3	5.4	5.8	5.8	5.9	5.9
Sta. 25186	5.4	4.6	6.0	5.3	6.9	5.7	5.6	4.2
U.S. Hwy 11	4.1	8.5	6.7	9.6	7.6	9.1	8.0	8.9
S. 28th Ave	5.1	4.1	6.7	5.2	9.3	5.8	10.6	6.0
Hillendale	3.8	3.5	3.9	4.4	3.7	4.9	3.7	5.0
S. 34th Ave	6.0	5.5	7.9	6.1	9.1	5.6	9.6	6.0
S. 40th Ave	3.3	3.3	3.6	3.7	4.5	4.6	4.9	5.0

Bank Protection. Riprap channel slope protection will be provided on the outside bank at all severe bends and on side slopes steeper than one vertical on three horizontal. There are 22 locations currently identified with a total of 5,870 linear feet of riprap slope protection required. Slope protection details showing riprap, bedding material, and filter fabric are shown on Chart 2-C-17.

Channel side slope protection from overland flow entry to the channel is provided, as needed, by the use of major and minor drainage structures as detailed on Chart 2-C-35 and located on Project Conditions Plan Views, Charts 2-C-12 to 2-C-16. The extensive urbanization within the basin has created a well defined drainage pattern that intercepts and routes overland flows to the main stem as point sources at the locations of the planned drainage structures. Further protection from overland flows is provided by the land owners (approximately 140) adjacent to the creek who intensively manage their property with lawns that often extend to the top of bank.

Riprap will also be placed at all bridge and culvert crossings. Riprap at bridges will extend 30 feet upstream and downstream from culvert entrances and bridge centerlines. Riprap will extend to five feet beyond top of bank and include protection of the abutments. Riprap for use in slope protection and bridge and culvert protection is designed in accordance with EM 1110-2-1601 and ETL 110-2-120 Guidance. Table 2-C-3, Riprap Design, shows actual design computations. Table 2-C-4, Riprap Gradations, shows typical riprap gradation data for various riprap blanket thicknesses.

TABLE 2-C-3

RIPRAP PROTECTION

BRIDGE COLUMN A	RIPRAP THICKNESS B (INCHES)	MINIMUM D50 C (FT)	CHANNEL VEL D (FPS)	LOCAL VEL E (FPS)	DEPTH F (FT)	LOCAL BOUNDARY SHEAR: TRACTIVE FORCE G FS=1.0	LOCAL BOUNDARY SHEAR: TRACTIVE FORCE H FS=1.5	COTAN SIDESLOPE I	RIPRAP DESIGN SHEAR: TRACTIVE FORCE J BOTTOM	RIPRAP DESIGN SHEAR: TRACTIVE FORCE K SIDE SL	
BROAD ST.	12	0.59	6.70	10.05	18.6	0.89	1.33	3	2.42	2.11	
N. 12TH AVE.	12	0.59	7.70	11.55	15.4	1.25	1.88	3	2.42	2.11	
HUTCHINSON AVE.	18	0.88	9.20	13.80	19.2	1.90	2.85	3	3.61	3.14	
STA 16368	24	1.17	9.40	14.10	13.2	2.55	3.83	3	4.80	4.18	
HARDY ST.	24	1.17	14.40	21.60	11.4	6.36	9.54	3	4.80	4.18	GROUTED
MS HWY 11 (BROADWAY)	18	0.88	8.80	13.20	11.7	2.09	3.14	3	3.61	3.14	
STA 22968	12	0.59	5.70	8.55	10.4	0.79	1.18	3	2.42	2.11	
US HWY 49	24	1.17	14.80	22.20	10.2	7.04	10.57	3	4.80	4.18	GROUTED
MS HWY 11	24	1.17	9.90	14.85	3.8	5.07	7.61	3	4.80	4.18	GROUTED
28TH AVE.	24	1.17	9.10	13.65	9.7	2.72	4.08	3	4.80	4.18	
HILLENDALE	18	0.88	10.00	15.00	10.0	2.88	4.32	3	3.61	3.14	GROUTED
CONDO RD.	18	0.88	9.00	13.50	9.2	2.41	3.62	3	3.61	3.14	GROUTED
NEW ENGLAND	18	0.88	9.70	14.55	8.0	2.97	4.46	3	3.61	3.14	GROUTED
S. 34TH AVE.	24	1.17	9.00	13.50	10.0	2.63	3.94	3	4.80	4.18	
LINCOLN RD. AT S. 40TH AVE.	18	0.88	9.80	14.70	7.6	3.10	4.6[illegible]	3	3.61	3.14	GROUTED

NOTES ON COMPUTATIONS:

COLUMN G = $\dfrac{62.4\,\bar{V}^2}{(32.6\,\log_{10}(12.2d/D50))^2}$ EQUATION 32 -- EM 1110-2-1601

COLUMN J = $0.04(165-62.4)D50$ EQUATION 33 -- EM 1110-2-1601

COLUMN K = $(\text{COL J})\left[1-\dfrac{\sin^2\phi}{\sin^2\theta}\right]^{1/2}$ EQUATION 34 -- EM 1110-2-1601

TABLE 2-C-4
RIPRAP GRADATIONS

ALL STONE : **

SPECIFIC WEIGHT = 165 PCF
LAYER THICKNESS = 1.00 D100(MAX)
= 1.50 D50(MAX)

	% LIGHTER BY WEIGHT	LIMITS OF STONE WEIGHT IN LBS.
FOR 12 INCH LAYER THICKNESS	100	86 - 35
	50	26 - 17
	15	13 - 5
FOR 18 INCH LAYER THICKNESS	100	292 - 117
	50	86 - 58
	15	43 - 18
FOR 24 INCH LAYER THICKNESS	100	691 - 276
	50	205 - 138
	15	102 - 43

** REFERENCE ETL 1110-2-120, INCL. 1

Bridge Replacement. As designed, two new culverts will be constructed. One culvert, consisting of two 10 x 15-foot barrels, will replace the two existing bridges at South 28th Avenue and Lincoln Road. This structure will replace two 90 degree bends that currently exist at this site. More importantly, economic evaluations indicated substantial damages caused by backwater from the existing structures.

The other culvert, consisting of two 8 x 12-foot barrels will replace the bridge at South 34th Avenue and the culvert immediately upstream under Lincoln Road. This culvert performs the same function as the previously discussed culvert, that is, it replaces two 90 degree bends and provides a much smoother transition into and exiting from the bridge opening.

Other bridges act as controls for the more infrequent floods. The U.S. Highway 11 crossings and U.S. Highway 49 are examples. But, upon examination of these structures it is apparent that residual damages are too low to justify the cost necessary to modify the structures. Other structures that exercise less control, affect flood elevations for only a short distance upstream (less than 200 feet). This is due to the stream's relatively steep slope in the upstream reaches above South 28th Avenue.

Transitions. No transitions from one channel bottom width to another will be required. As proposed, the channel widths change at existing structures. A typical transition to a bridge section is shown on Chart 2-C-18. It is designed to maintain minimum variation in cross-sectional area in accordance with the recommendations in the Design of Open Channels, October 1977, TR No. 5.

Relocations. There are nine sewer, eight water, and two gas pipe lines that cross the stream in the project area. These pipe lines currently cross the stream at or above the existing channel invert. Under project conditions, they will be modified to cross below the new channel invert. In addition to the pipe lines, approximately 500 feet of 7.2 KW electrical lines will be relocated. Relocations are shown on Charts No. 2-C-12 through 2-C-16.

Disposal. The City of Hattiesburg has indicated that a suitable site for disposal of excavated material is located at the existing landfill near the mouth of Gordons Creek. Approximately 9 acres of land will be required for disposal of material at a depth of 12 feet.

Hydraulic Data. Flood frequency profiles were computed with the selected plan for the 2-,5-,10-,25-,50-,100-,500-year frequency and Standard Project Floods. These profiles are presented on Charts No. 2-C-12 through 2-C-16. Charts No. 2-C-19 through 2-C-23 compare profiles with and without project for the 10-year frequency flood. Charts No. 2-C-24 through 2-C-28 compare profiles with and without project for the 100-year frequency flood. Charts No. 2-C-29 through 2-C-33 compare profiles with and without project for the 500-year frequency flood. Maximum reductions for the 10-year frequency flood are as much as 4 feet in some reaches.

Along the existing Gordons Creek Project, downstream of Broad Street, flood stages are increased slightly. The 10-year flood frequency event increases up to 0.5 foot. The 100-year event increases as much as 0.6 foot. Several measures were evaluated to address this situation. A complete description of the measures evaluated are contained in Appendix 5, in the report on Mitigation of Impacts on the Existing Project.

Costs. Detailed cost estimates for all plans evaluated are presented in Tables 2-E-1 through 2-E-15, Section E of this Appendix.

Damages. Table 2-C-3 contains flood damage information by reach for existing and project conditions. This table illustrates the relative effectiveness of the proposed project reach by reach. The reach locations are shown on Chart No. 1-C-1 in Appendix 1.

TABLE 2-C-5
Elevation-Damage Values by Reach
(Elevation in feet, Damage in $1,000)

REACH 1: Mouth of Gordons Creek to Main Street

Subreach 1A

Flood Level	Existing Conditions		Project Conditions	
	Elevation	Damage	Elevation	Damage
5	141.3	0.65	141.4	0.76
10	142.2	4.62	142.3	5.98
25	143.0	16.90	143.0	15.50
50	143.8	75.17	144.0	85.70
100	144.6	187.24	144.7	206.17
500	146.6	729.55	146.6	739.28
SPF	148.4	1252.67	148.4	1263.28

Subreach 1B

Flood Level	Existing Conditions		Project Conditions	
	Elevation	Damage	Elevation	Damage
5	144.4	0.00	144.5	0.00
10	145.3	0.00	145.4	0.00
25	145.9	0.00	146.0	0.00
50	146.2	0.41	146.4	0.68
100	146.8	1.31	147.0	1.70
500	148.0	42.60	148.1	49.64
SPF	149.3	216.19	149.4	226.94

Subreach 1C

Flood Level	Existing Conditions		Project Conditions	
	Elevation	Damage	Elevation	Damage
5	145.6	0.00	145.7	0.00
10	146.5	0.00	146.6	0.00
25	147.0	0.00	147.0	0.00
50	147.2	3.24	147.5	7.05
100	147.8	10.86	148.0	14.10
500	149.0	33.02	149.1	34.32
SPF	150.0	48.90	150.2	48.90

TABLE 2-C-5 (Continued)
Elevation-Damage Values by Reach
(Elevation in feet, Damage in $1,000)

REACH 2: Main Street to Broad Street [1/]

Subreach 2A

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	146.7	0.00	146.8	0.00
10	147.8	0.00	147.9	0.00
25	148.4	4.44	148.4	4.80
50	148.6	7.68	149.0	12.00
100	149.5	39.70	149.8	53.04
500	150.7	103.01	150.7	104.13
SPF	151.9	162.33	152.0	168.40

Subreach 2B

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	149.2	0.00	149.2	0.00
10	150.6	0.00	150.9	0.00
25	151.4	0.00	151.5	0.00
50	151.7	0.00	152.1	8.09
100	152.6	48.54	153.1	86.71
500	154.7	165.49	154.9	171.22
SPF	156.7	207.44	156.1	222.10

Subreach 2C

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	150.6	0.00	150.7	0.00
10	152.0	0.00	152.2	0.00
25	152.6	0.00	152.7	0.00
50	152.8	0.00	153.3	0.00
100	153.8	0.00	154.4	2.68
500	156.2	137.07	156.4	148.10
SPF	157.6	324.09	158.0	401.90

1/ Refer to Appendix 1 Section E for mitigation and evacuation to reduce induced damages.

TABLE 2-C-5 (Continued)
Elevation-Damage Values by Reach
(Elevation in feet, Damage in $1,000)

Subreach 2D

Flood Level	Existing Conditions		Project Conditions	
	Elevation	Damage	Elevation	Damage
5	153.1	11.47	153.2	12.04
10	154.2	19.22	154.5	23.40
25	154.9	29.30	155.3	33.21
50	155.3	33.21	155.8	37.56
100	155.9	38.69	156.4	48.86
500	157.3	108.44	157.6	145.46
SPF	158.9	733.84	159.2	774.00

Subreach 2E

Flood Level	Existing Conditions		Project Conditions	
	Elevation	Damage	Elevation	Damage
5	155.5	1.80	155.8	2.82
10	156.7	24.74	157.0	30.62
25	157.1	34.70	157.5	40.10
50	157.5	40.40	157.9	46.10
100	157.9	46.55	158.3	50.75
500	158.8	56.31	159.2	96.2[illegible]
SPF	160.4	248.80	160.6	248.80

Subreach 2F

Flood Level	Existing Conditions		Project Conditions	
	Elevation	Damage	Elevation	Damage
5	156.7	2.85	157.0	4.00
10	158.1	84.66	158.6	227.32
25	158.8	286.76	159.2	383.04
50	159.3	397.78	159.7	475.14
100	159.6	460.40	159.7	475.14
500	159.9	515.66	160.2	558.84
SPF	161.3	672.60	161.2	672.60

TABLE 2-C-5 (Continued)
Elevation-Damage Values by Reach
(Elevation in feet, Damage in $1,000)

Subreach 2G

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	158.5	8.83	158.8	14.98
10	159.8	70.65	160.1	100.51
25	160.3	129.28	160.8	188.08
50	160.8	188.08	161.3	269.83
100	161.2	245.25	161.5	307.65
500	161.7	347.36	162.1	421.07
SPF	163.2	590.90	163.4	590.90

REACH 3: Broad Street to Lurty Avenue

Subreach 3A

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	159.9	0.00	160.0	0.00
10	161.2	6.48	161.5	10.50
25	162.0	17.20	162.2	26.44
50	162.5	40.30	162.8	54.16
100	162.9	58.78	163.1	74.66
500	163.6	130.96	163.6	130.96
SPF	165.0	328.20	164.8	297.76

Subreach 3B

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	161.4	0.00	160.2	0.00
10	162.5	0.00	161.7	0.00
25	163.2	0.00	162.5	0.00
50	163.7	0.00	163.0	0.00
100	164.1	0.00	163.3	0.00
500	164.8	0.00	163.8	0.00
SPF	166.2	78.06	165.1	1.07

TABLE 2-C-5 (Continued)
Elevation-Damage Values by Reach
(Elevation in feet, Damage in $1,000)

Subreach 3C

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	162.5	0.00	160.4	0.00
10	163.6	0.00	161.9	0.00
25	164.2	0.00	162.6	0.00
50	164.7	0.00	163.2	0.00
100	165.2	0.00	163.5	0.00
500	165.8	0.00	164.1	0.00
SPF	167.2	223.84	165.4	0.00

Subreach 3D

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	164.8	0.00	161.7	0.00
10	165.8	0.00	163.1	0.00
25	166.6	4.32	164.0	0.00
50	167.2	15.84	164.6	0.00
100	167.6	33.12	165.1	0.00
500	168.2	70.00	166.0	0.00
SPF	170.4	321.26	168.1	60.20

REACH 4: Lurty Street to Hardy Street

Subreach 4A

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	167.6	510.96	162.7	0.00
10	168.4	868.92	164.1	1.06
25	169.1	1243.88	164.9	9.54
50	169.6	1575.78	165.6	50.14
100	170.0	1841.30	166.1	97.11
500	170.6	2119.46	167.0	282.60
SPF	171.9	2631.24	169.0	1177.50

TABLE 2-C-5 (Continued)
Elevation-Damage Values by Reach
(Elevation in feet, Damage in $1,000)

Subreach 4B

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	169.2	88.48	164.0	0.00
10	170.0	207.60	165.2	0.00
25	170.5	322.00	166.0	0.00
50	170.8	390.64	166.6	0.00
100	171.2	488.68	167.2	1.50
500	171.7	619.38	168.1	12.62
SPF	172.9	1006.05	169.8	177.82

REACH 5: Hardy Street to Eva Street 1/

Subreach 5A

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	170.2	0.00	166.3	0.00
10	171.1	1.27	167.4	0.00
25	171.6	7.62	168.2	0.00
50	172.1	13.51	169.2	0.00
100	172.7	18.37	169.8	0.00
500	173.6	24.64	171.3	3.81
SPF	175.2	65.90	174.8	58.16

Subreach 5B

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	172.5	0.00	172.5	0.00
10	173.5	3.75	173.5	3.75
25	174.1	11.29	174.3	18.87
50	174.8	37.82	174.9	41.61
100	175.3	72.01	175.2	63.14
500	176.3	170.88	176.9	125.23
SPF	177.9	358.13	178.2	369.40

1/ Refer to Appendix 1 Section E for mitigation and evacuation to reduce induced damages.

TABLE 2-C-5 (Continued)
Elevation-Damage Values by Reach
(Elevation in feet, Damage in $1,000)

REACH 6: Eva Street to Adeline Street 1/

Subreach 6A

Flood Level	Existing Conditions		Project Conditions	
	Elevation	Damage	Elevation	Damage
5	173.7	0.00	172.8	0.00
10	174.2	0.04	174.4	0.08
25	174.7	0.14	174.9	0.18
50	175.2	3.74	175.3	5.51
100	175.6	10.82	175.5	9.05
500	176.4	45.86	176.1	24.89
SPF	178.1	236.90	178.3	236.90

Subreach 6B

Flood Level	Existing Conditions		Project Conditions	
	Elevation	Damage	Elevation	Damage
5	177.3	64.58	177.5	78.30
10	178.1	119.83	178.4	141.52
25	178.7	163.21	178.9	177.67
50	179.1	197.43	179.2	209.96
100	179.5	247.55	179.4	235.02
500	180.3	379.92	180.0	310.20
SPF	180.9	519.36	181.2	542.60

REACH 7: Adeline Street to U.S. Highway 11 1/

Subreach 7A

Flood Level	Existing Conditions		Project Conditions	
	Elevation	Damage	Elevation	Damage
5	179.7	23.57	179.8	26.88
10	180.3	78.29	180.6	123.08
25	180.9	167.87	181.1	209.60
50	181.2	236.40	181.2	236.40
100	181.4	290.00	181.3	263.20
500	181.8	397.20	181.7	370.40
SPF	182.7	651.21	182.9	708.47

1/ Refer to Appendix 1 Section E for mitigation and evacuation to reduce induced damages.

TABLE 2-C-5 (Continued)
Elevation-Damage Values by Reach
(Elevation in feet, Damage in $1,000)

Subreach 7B

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	180.5	3.80	180.5	3.80
10	181.2	16.98	181.4	26.46
25	181.7	40.68	181.9	50.16
50	182.1	64.96	182.1	64.96
100	182.3	85.08	182.3	85.08
500	182.8	135.38	182.7	125.32
SPF	183.8	238.22	184.0	258.90

Subreach 7C

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	181.8	0.00	182.0	0.00
10	182.5	0.00	182.8	0.00
25	183.0	0.00	183.3	0.00
50	183.4	0.00	183.5	0.00
100	183.8	0.00	183.7	0.00
500	184.4	26.84	184.3	20.13
SPF	185.3	181.25	185.5	257.35

REACH 8: U.S. Highway 11 to U.S Highway 49

Subreach 8A

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	184.4	0.00	184.4	0.00
10	185.4	0.00	185.5	0.00
25	187.1	21.86	186.3	0.00
50	188.3	431.33	186.6	0.00
100	189.1	1003.86	189.0	927.70
500	190.2	1813.66	190.2	1813.66
SPF	190.5	2000.20	190.5	2000.20

TABLE 2-C-5 (Continued)
Elevation-Damage Values by Reach
(Elevation in feet, Damage in $1,000)

Subreach 8B

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	187.9	324.33	185.0	0.00
10	188.5	422.00	186.1	5.91
25	188.6	435.64	186.8	47.28
50	188.9	476.56	187.1	88.57
100	189.5	639.05	189.1	519.97
500	190.5	1068.15	190.2	900.00
SPF	190.9	1292.35	190.7	1180.25

REACH 9: U.S. Highway 49 to Lincoln Road

Subreach 9A

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	193.9	255.94	192.5	36.50
10	195.0	364.20	193.8	235.48
25	195.7	370.22	194.8	346.64
50	196.1	374.64	195.7	370.22
100	196.6	383.84	196.6	383.84
500	197.4	406.84	197.5	410.75
SPF	198.5	497.25	198.8	537.42

REACH 10: Lincoln Road to Marie Street

Subreach 10A

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	198.0	0.00	197.5	0.00
10	198.8	0.00	198.6	0.00
25	199.6	0.00	199.5	0.00
50	200.2	4.88	200.4	9.76
100	201.0	24.40	201.1	30.43
500	202.4	98.18	202.7	108.29
SPF	204.9	180.92	205.6	182.50

TABLE 2-C-5 (Continued)
Elevation-Damage Values by Reach
(Elevation in feet, Damage in $1,000)

REACH 11: Marie Street to 28th Avenue

Subreach 11A

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	202.8	540.86	202.0	316.30
10	203.4	768.68	202.6	484.72
25	203.7	897.44	202.9	568.93
50	203.8	940.36	203.1	639.92
100	203.9	983.28	203.3	725.76
500	204.0	1026.20	203.7	897.44
SPF	205.0	1570.00	205.8	1570.00

Subreach 11B

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	204.8	19.72	204.5	14.65
10	205.4	43.98	205.2	33.54
25	205.8	64.86	205.6	54.42
50	206.2	106.30	206.2	106.30
100	206.5	152.80	206.5	152.80
500	207.2	274.40	207.1	252.35
SPF	208.4	570.60	208.1	480.75

Subreach 11C

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	207.4	0.00	206.0	0.00
10	209.1	21.49	206.7	0.00
25	209.4	42.76	207.2	0.00
50	209.6	56.94	207.8	0.00
100	209.8	72.12	208.1	1.44
500	210.5	251.85	208.9	12.96
SPF	211.4	478.84	210.2	151.92

TABLE 2-C-5 (Continued)
Elevation-Damage Values by Reach
(Elevation in feet, Damage in $1,000)

REACH 12: 28th Avenue to 34th Avenue

Subreach 12A

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	209.5	4.35	206.8	0.00
10	209.8	6.96	207.4	0.00
25	210.2	13.38	208.1	0.00
50	212.1	94.82	208.6	0.00
100	212.3	121.06	209.1	0.87
500	213.4	275.02	210.0	8.70
SPF	215.2	591.00	214.0	368.20

Subreach 12B

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	211.7	27.37	208.8	0.00
10	212.7	68.03	209.8	[illegible].92
25	213.4	97.94	210.5	5.55
50	213.6	104.96	211.2	13.34
100	214.1	129.94	211.8	26.58
500	214.8	206.52	213.0	83.90
SPF	215.6	262.24	213.9	115.49

Subreach 12C

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	212.1	22.39	209.1	0.24
10	213.0	56.50	210.0	2.40
25	213.7	138.68	210.8	7.60
50	213.9	162.16	211.4	12.78
100	214.2	220.90	212.0	18.60
500	214.9	385.40	213.2	79.98
SPF	215.7	617.43	214.0	173.90

TABLE 2-C-5 (Continued)
Elevation-Damage Values by Reach
(Elevation in feet, Damage in $1,000)

Subreach 12D

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	213.1	11.69	212.5	4.35
10	214.1	49.95	213.6	26.64
25	215.1	179.73	214.6	106.70
50	216.2	473.98	215.5	290.25
100	216.3	496.77	215.5	290.25
500	216.6	565.14	215.5	290.25
SPF	216.9	633.51	215.6	317.88

Subreach 12E

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	214.9	53.91	213.7	0.00
10	215.7	225.52	215.1	83.56
25	216.3	395.95	215.8	249.18
50	216.7	528.55	216.0	296.50
100	217.2	701.68	216.2	362.80
500	217.7	885.88	216.5	462.25
SPF	218.3	1130.32	216.9	594.85

Subreach 12F

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	217.6	59.96	216.6	13.62
10	218.4	119.68	217.5	53.75
25	219.2	212.86	218.4	119.68
50	219.9	355.87	219.8	335.44
100	220.2	427.78	220.0	376.30
500	220.6	530.74	220.3	453.52
SPF	221.2	697.64	220.8	582.22

TABLE 2-C-5 (Continued)
Elevation-Damage Values by Reach
(Elevation in feet, Damage in $1,000)

REACH 13: 34th Avenue to 40th Avenue

Subreach 13A

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	224.2	260.52	219.8	0.00
10	224.5	320.40	220.9	0.00
25	224.7	360.32	221.7	0.00
50	224.9	400.24	222.6	31.14
100	225.0	420.20	223.1	68.77
500	225.2	467.90	223.3	102.51
SPF	225.6	563.30	223.7	169.99

Subreach 13B

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	225.0	125.40	220.8	0.00
10	226.0	343.30	221.7	0.00
25	226.2	380.38	222.4	0.00
50	226.4	417.46	223.2	3.46
100	226.7	473.08	223.7	12.11
500	227.2	558.66	224.1	28.11
SPF	228.0	678.50	224.7	92.97

Subreach 13C

Subreach 13C contains no damageable property.

Subreach 13D

Flood Level	Existing Conditions Elevation	Existing Conditions Damage	Project Conditions Elevation	Project Conditions Damage
5	229.8	0.00	227.6	0.00
10	230.5	20.75	228.3	0.00
25	230.9	37.35	228.9	0.00
50	231.3	79.84	229.4	0.00
100	231.6	118.18	229.8	0.00
500	232.2	206.98	230.6	24.90
SPF	232.8	320.02	231.4	92.62

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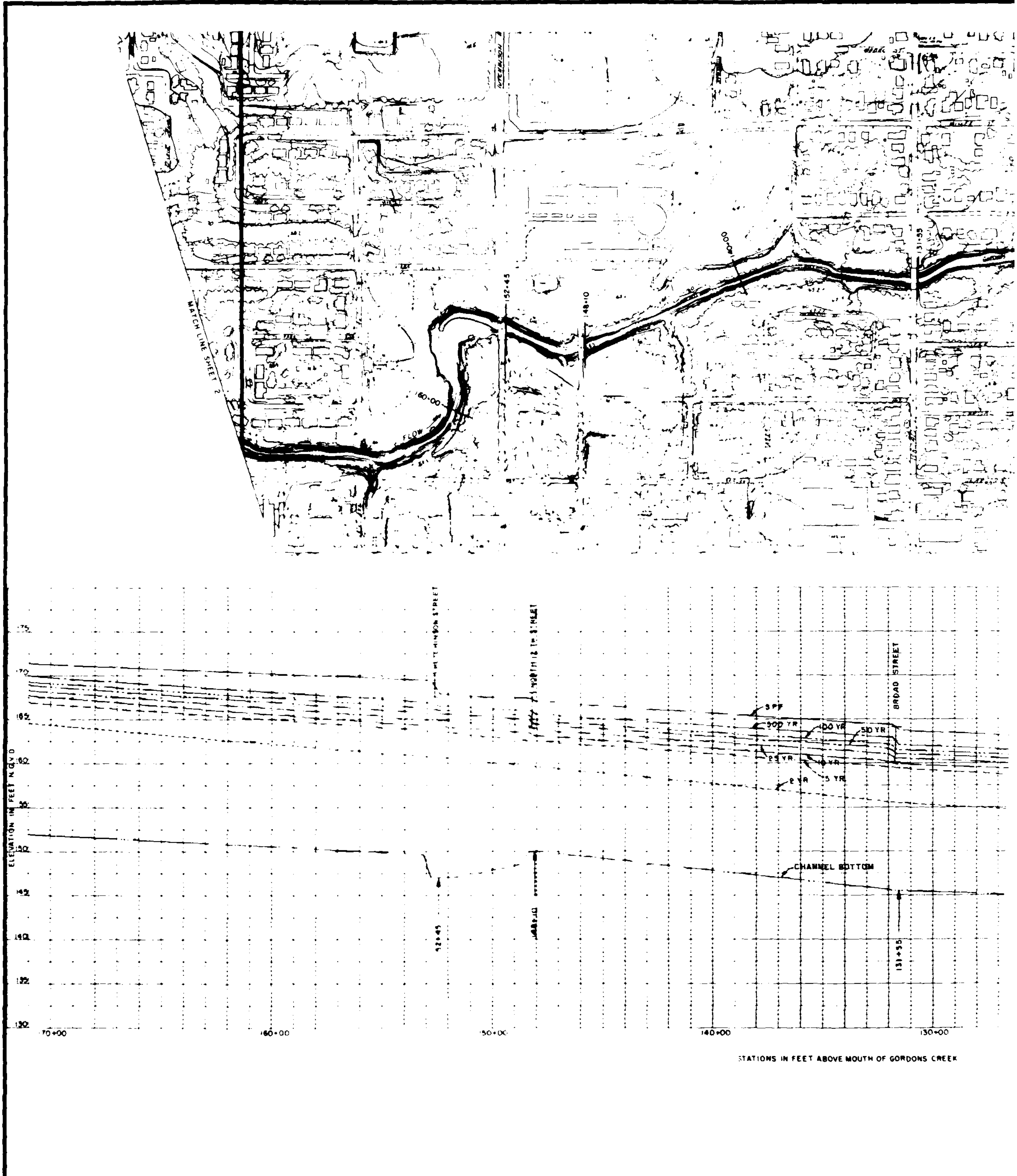

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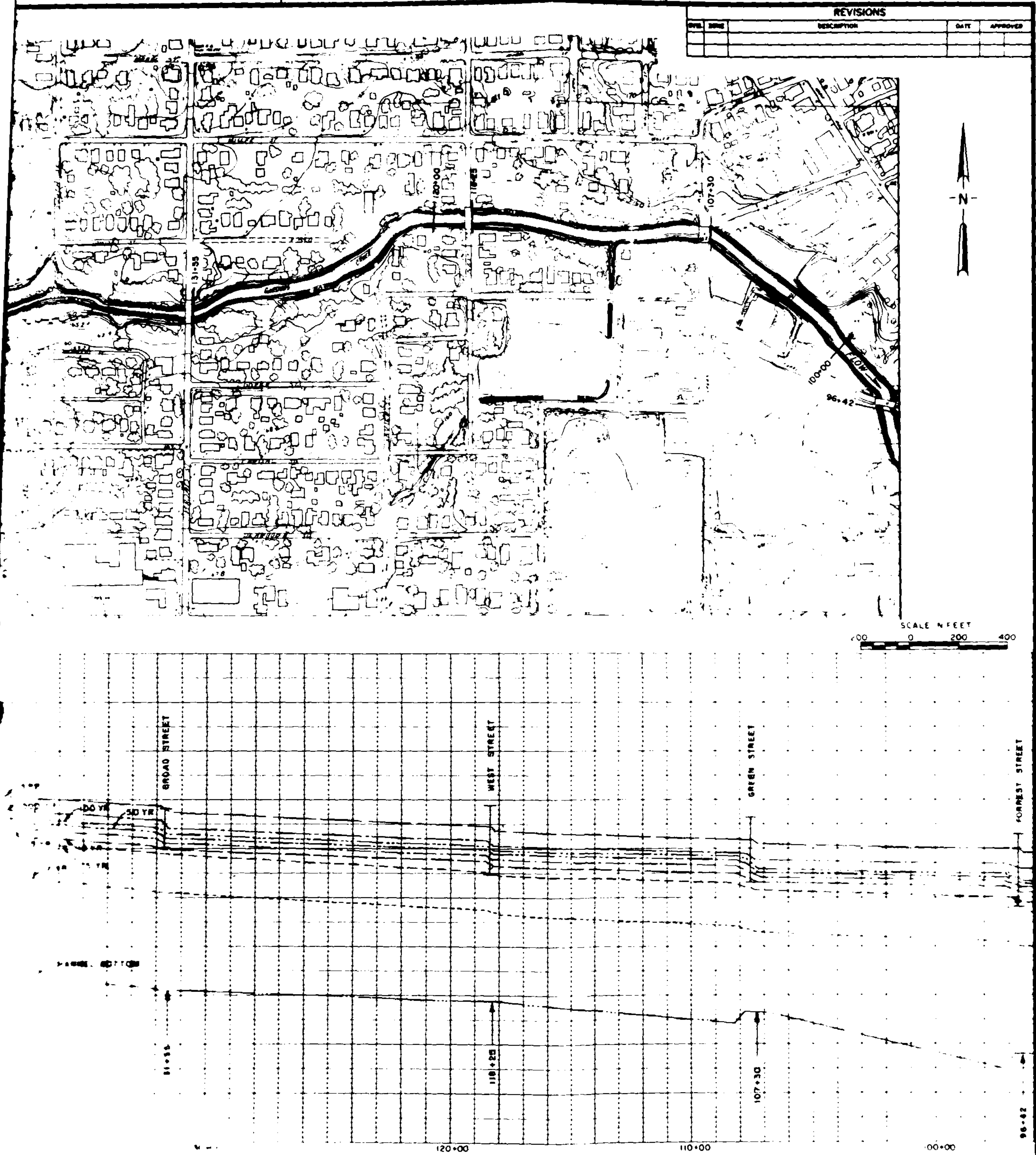

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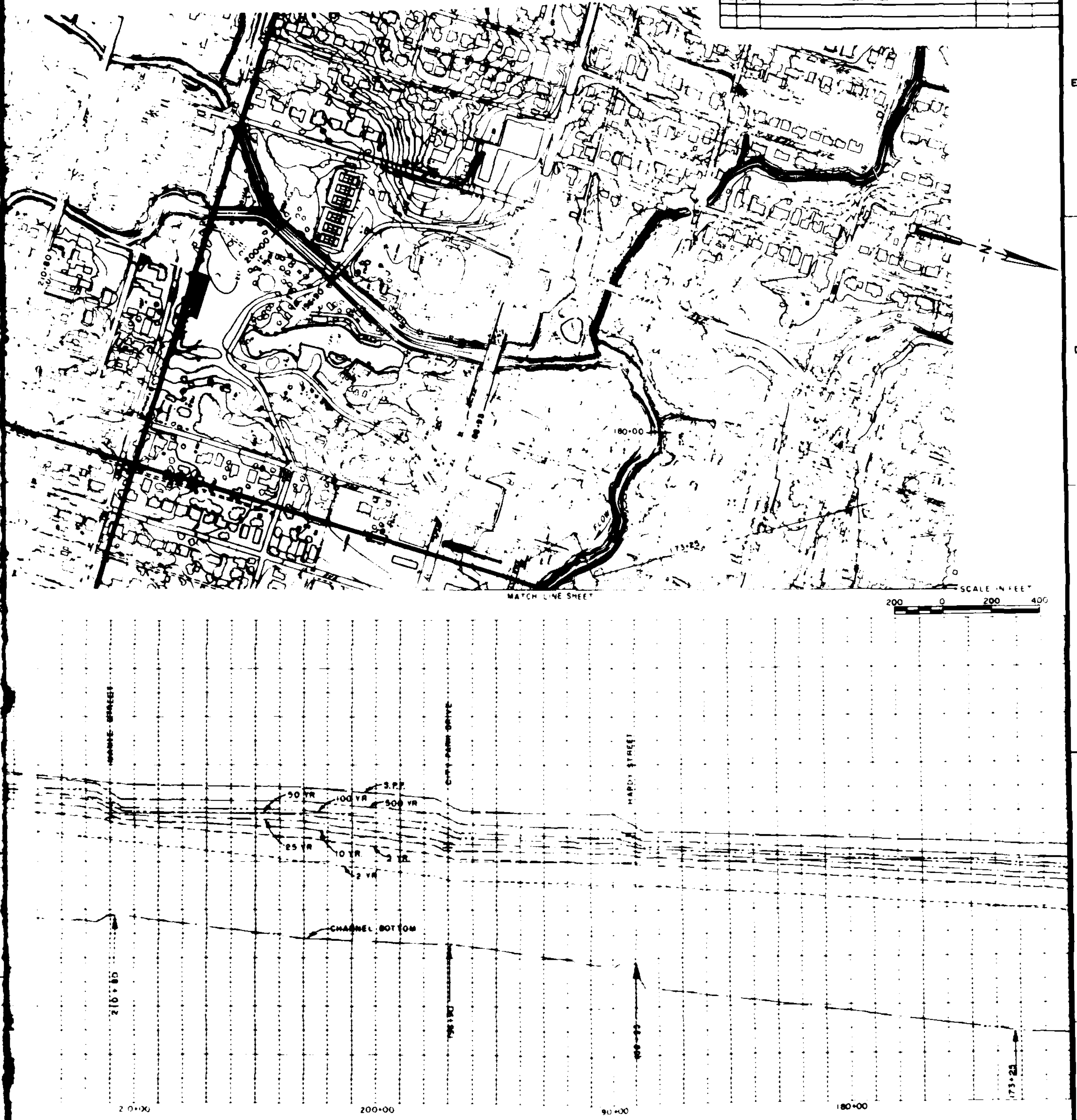
MOBILE, ALA

UPPER GORDONS CREEK FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
FLOOD FREQUENCY PROFILES.
EXISTING CONDITIONS

SCALE | DATE | SHEET 1 OF 5

CORPS OF ENGINEERS | 4 | 3

5 | 4 | 3



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U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

UPPER GORDONS CREEK FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI

FLOOD FREQUENCY PROFILES.
EXISTING CONDITIONS

SHEET 2 OF 5

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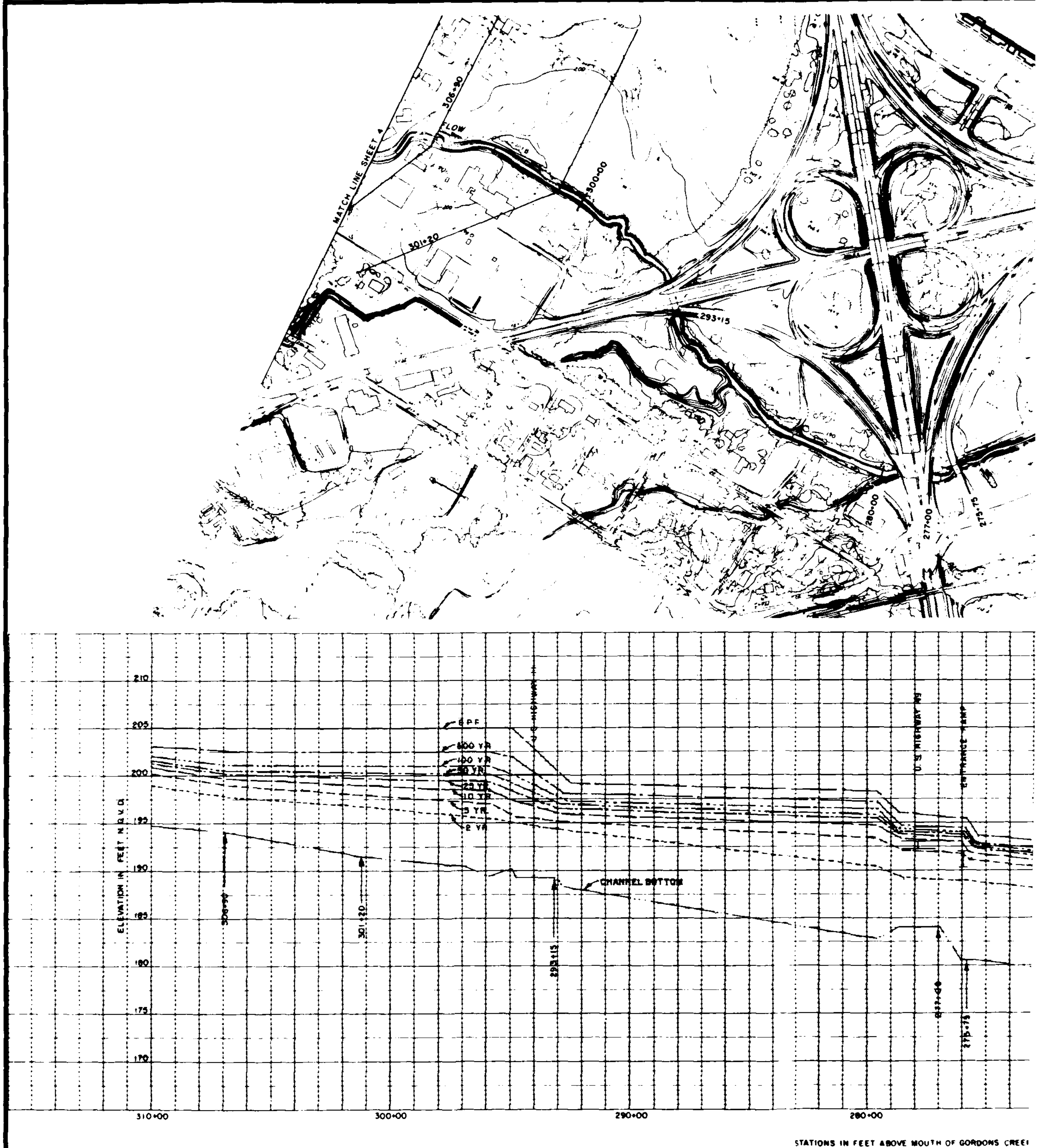

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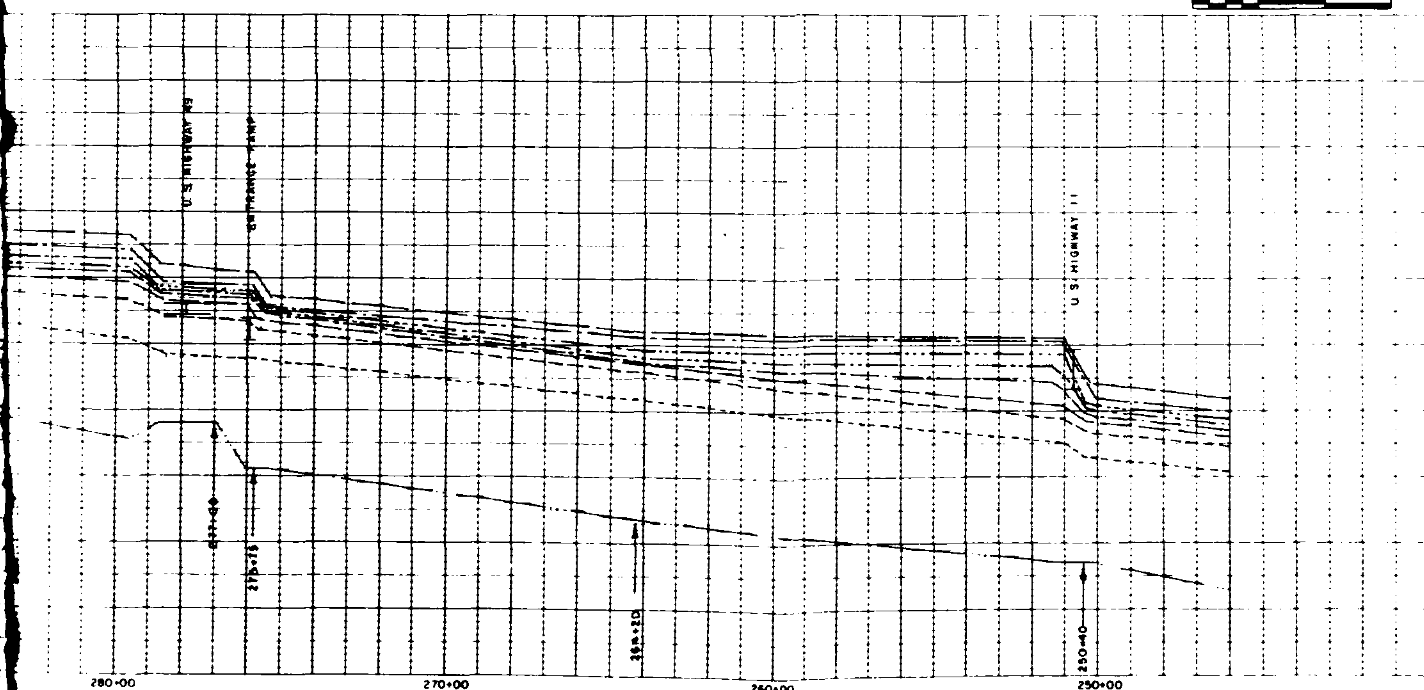

STATIONS IN FEET ABOVE MOUTH OF GORDONS CREEK

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

HATTIESBURG, MISSISSIPPI

FLOOD FREQUENCY PROFILES
EXISTING CONDITIONS

APPENDIX 2, CHART NO. 2-C-3

CORPS OF ENGINEERS

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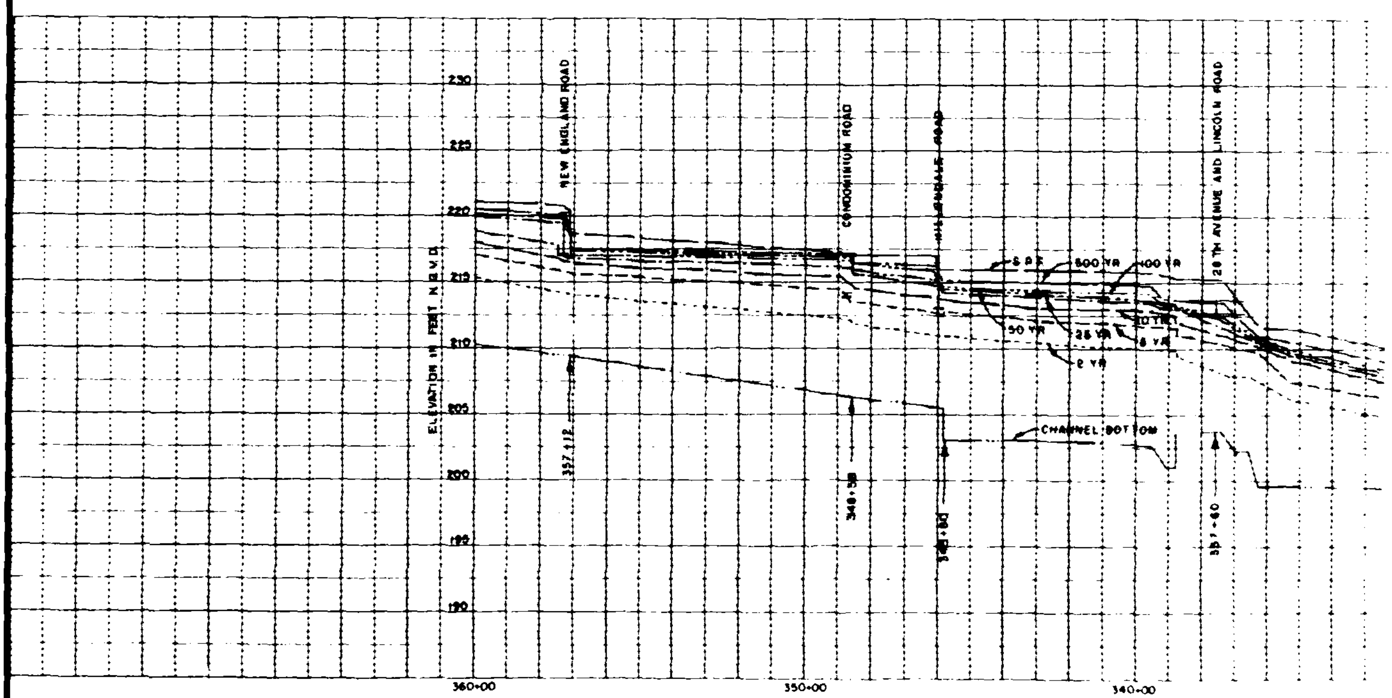

STATIONS IN FEET ABOVE MOUTH OF GORDON

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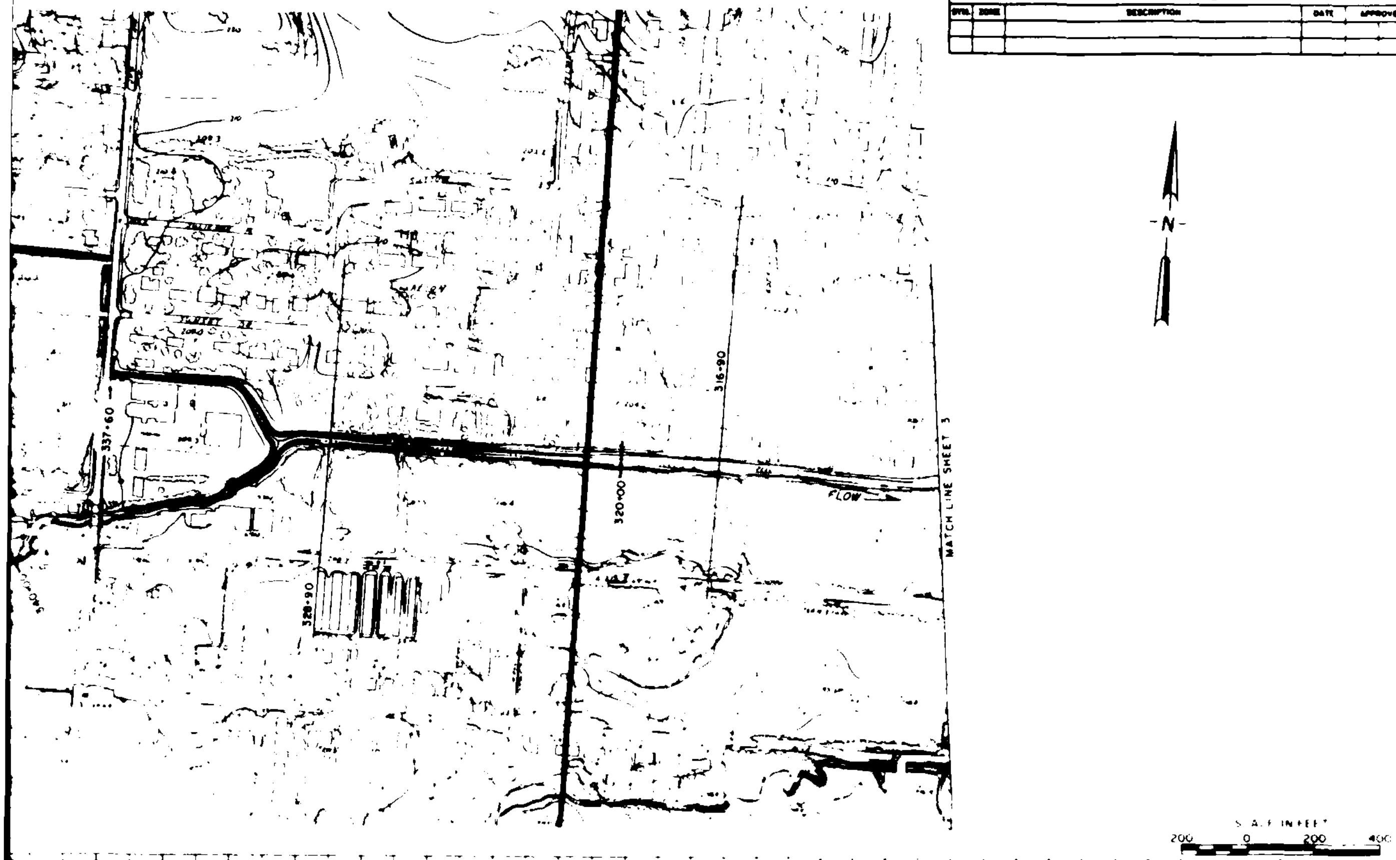
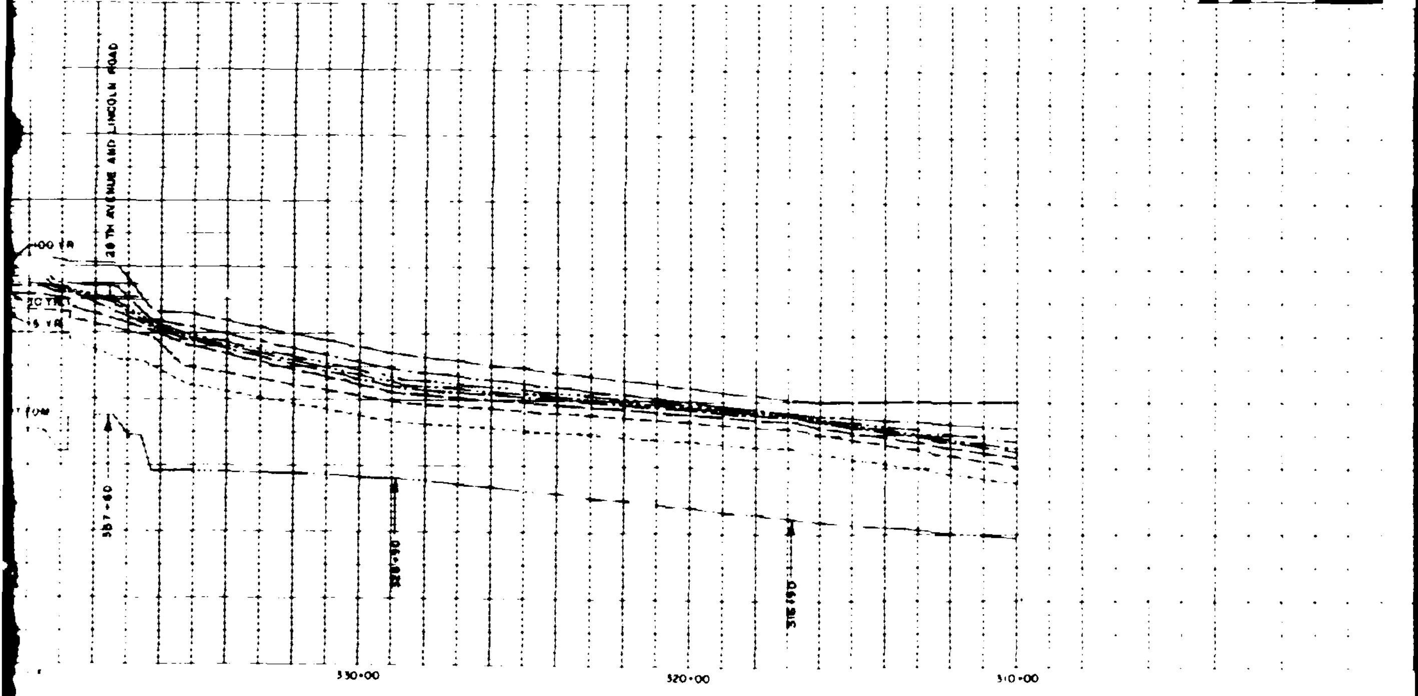
U. S. ARMY





...N IN FEET ABOVE MOUTH OF GORDONS CREEK

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA

HATTIESBURG, MISSISSIPPI

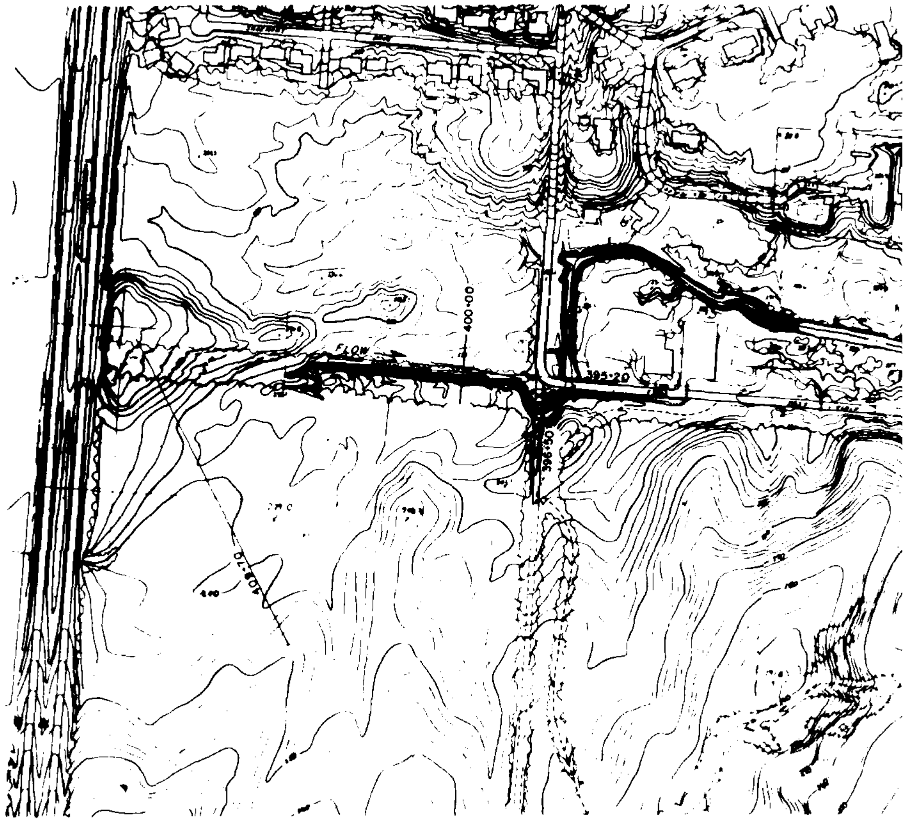
FLOOD FREQUENCY PROFILES

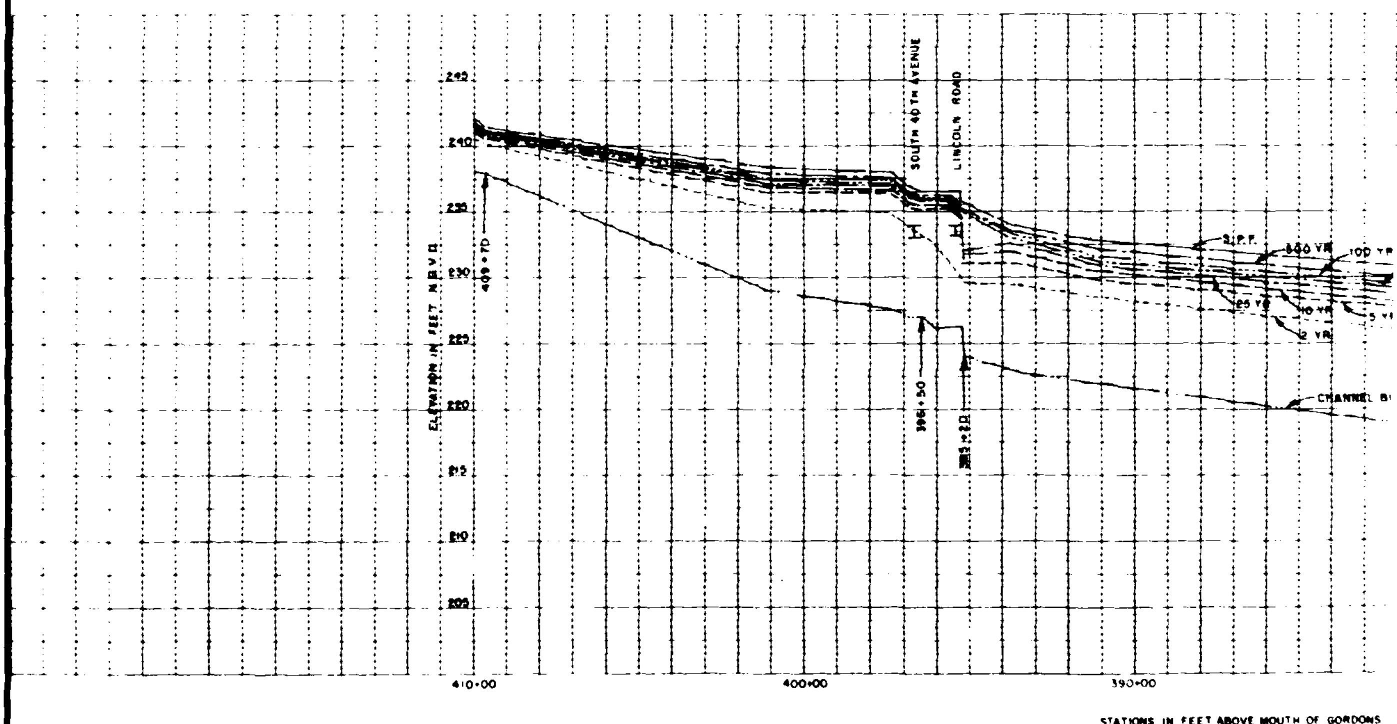
EXISTING CONDITIONS

SHEET 4 OF 5

APPENDIX 2, CHART NO 2-C-4

CORPS OF ENGINEERS | 4 | 3





5 | 4 | 3

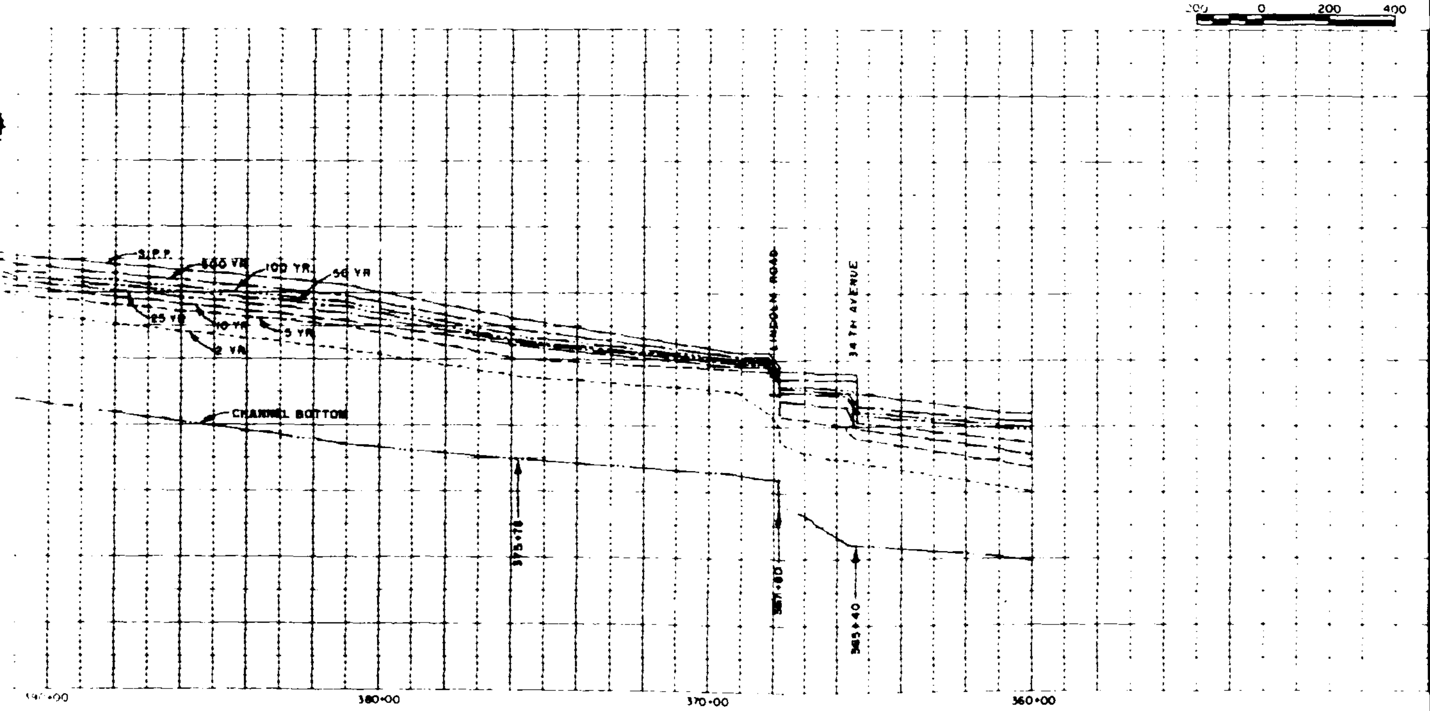
3 | 2 | 1 U. S. ARMY

REVISIONS

SYM.	ZONE	DESCRIPTION	DATE	APPROVED

-N-

SCALE IN FEET
200 0 200 400



TATIONS IN FEET ABOVE MOUTH OF GORDONS CREEK

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA

UPPER GORDONS CREEK FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI

FLOOD FREQUENCY PROFILES
EXISTING CONDITIONS

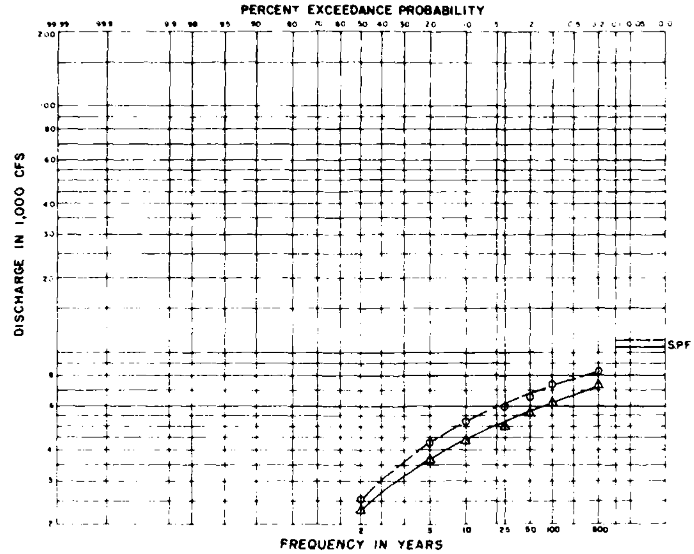
SHEET 5 OF 5

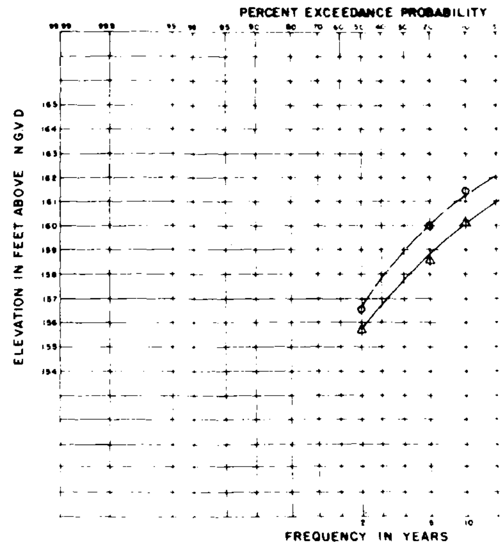
2

APPENDIX 2, CHART NO. 2-C-5

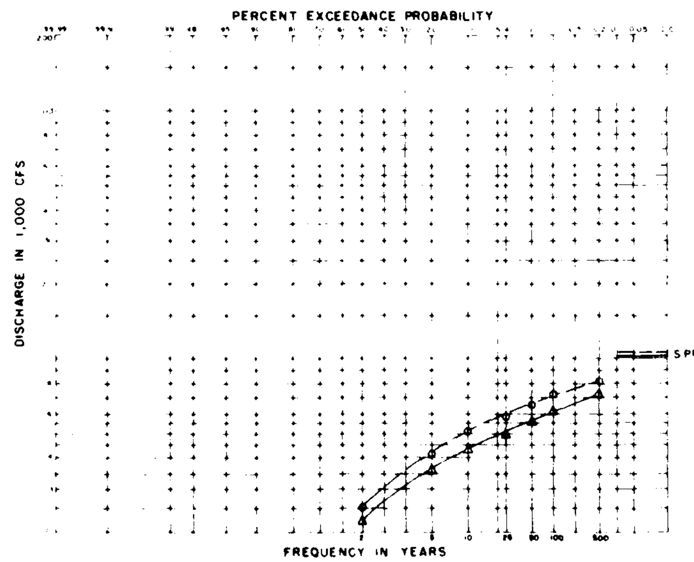
3 | 2

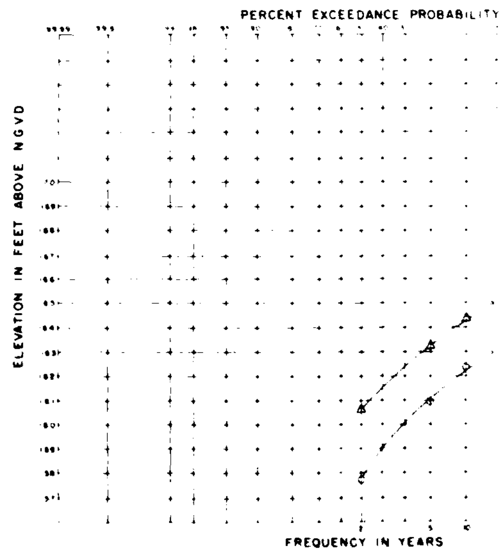
CORPS OF ENGINEERS | 4 | 3





STATION 132+23 (UPSTREAM BROAD S



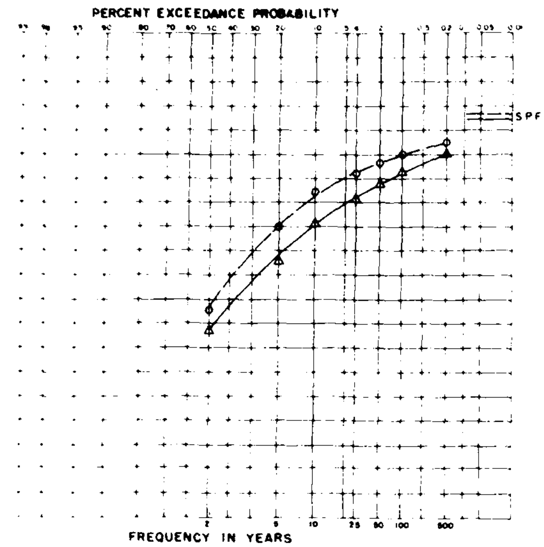


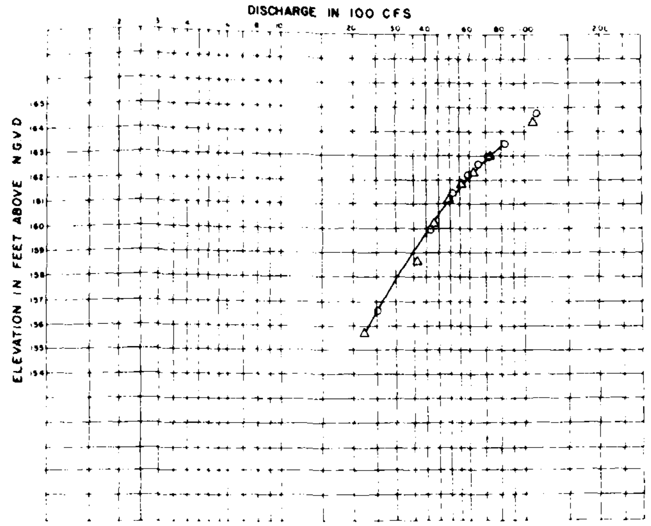
STATION 152+79 (UPSTREAM HUTCHINSO

5 | 4 | 3

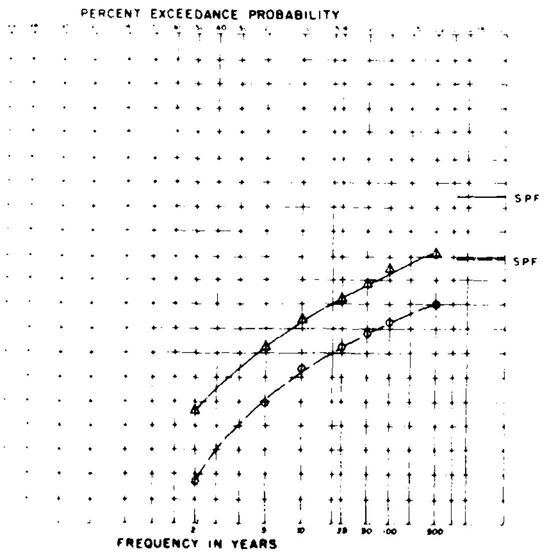
U. S. ARMY

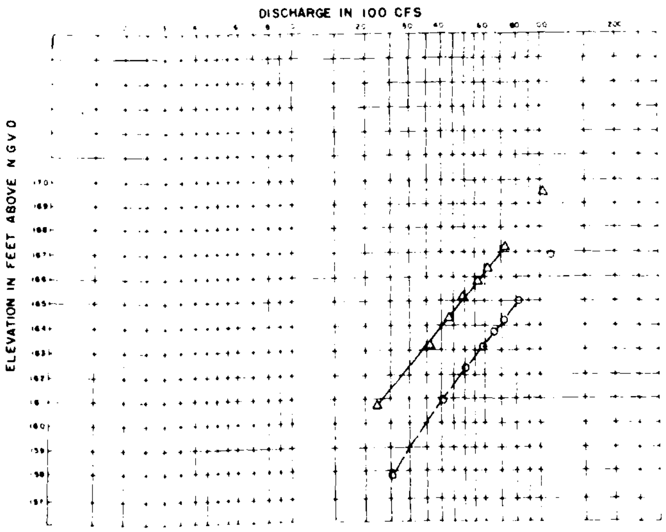
REVISIONS				
SYM	ZONE	DESCRIPTION	DATE	APPROVED





STATION 132+23 (UPSTREAM BROAD STREET)





STATION 152+79 (UPSTREAM HUTCHINSON AVENUE)

LEGEND

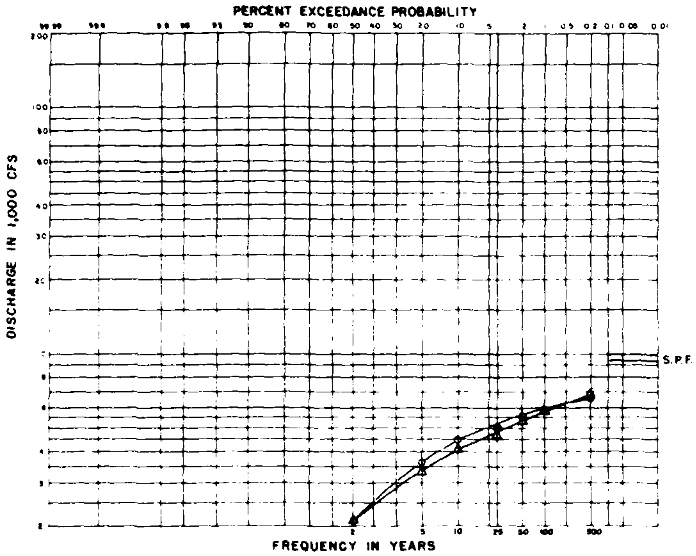
△———△ EXISTING CONDITION

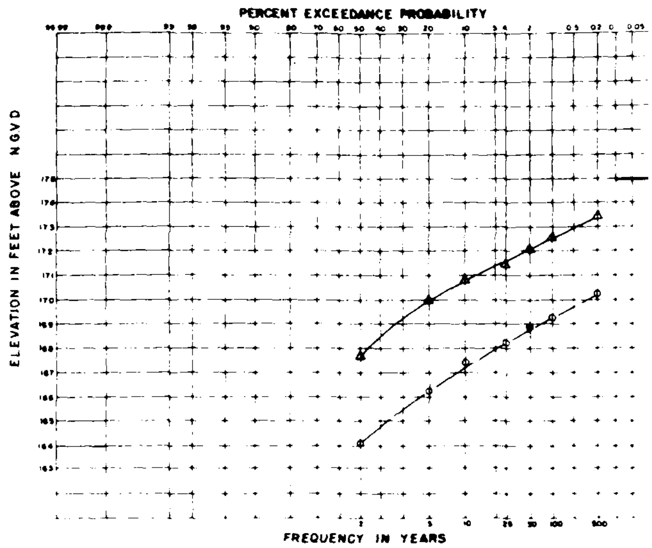
○— — —○ PROJECT CONDITION

U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

UPPER GORDONS CREEK FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
DISCHARGE - STAGE - FREQUENCY CURVES

SHEET 1 OF 5





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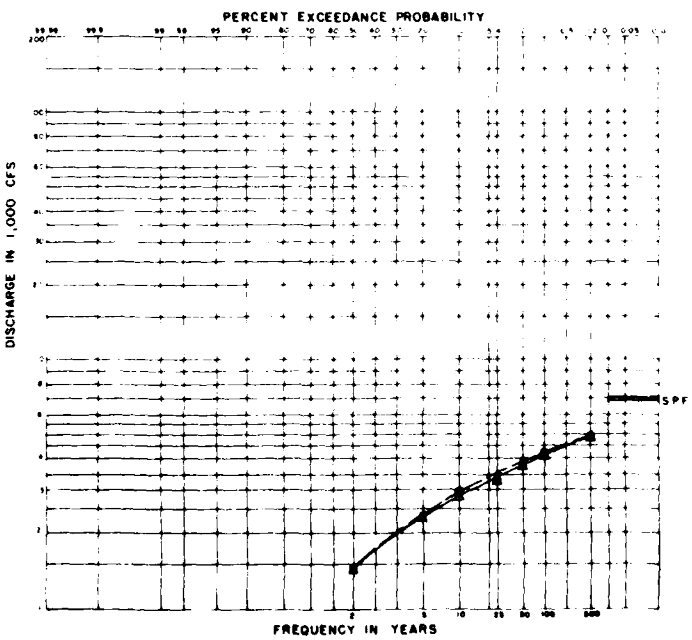
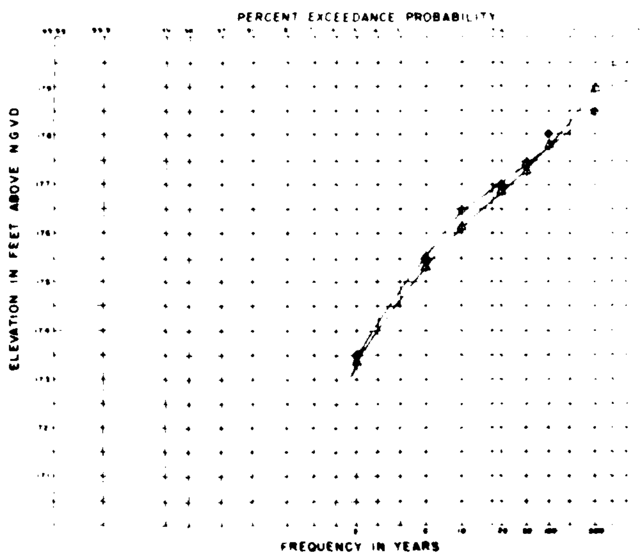


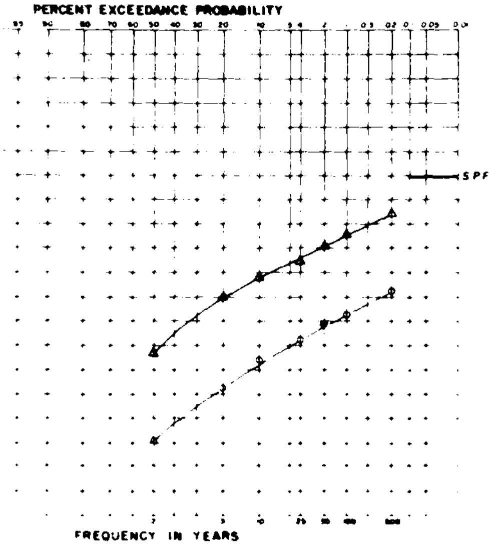


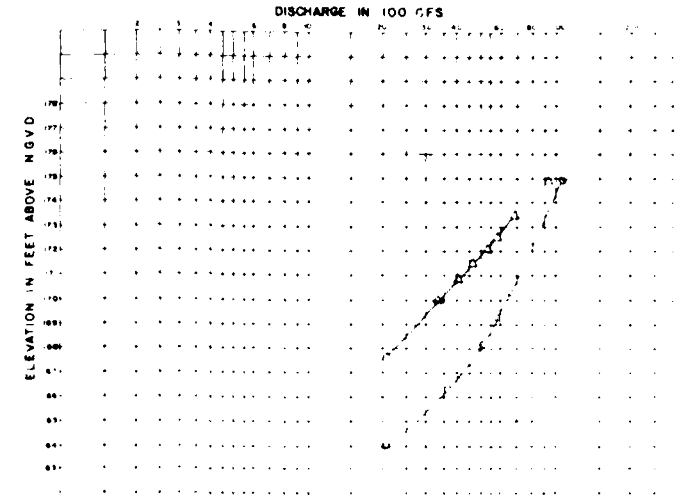
STATION 214+90

U. S. ARMY

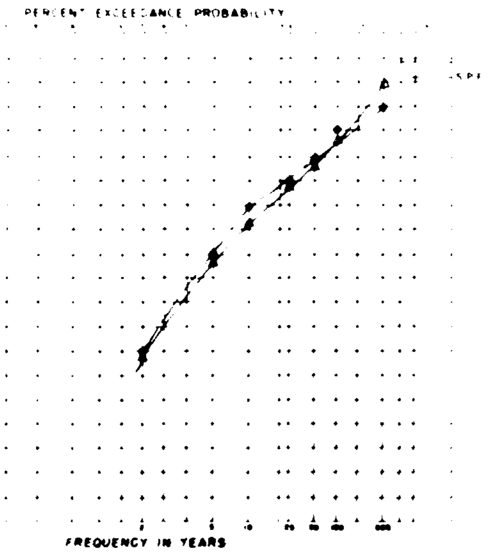
REVISIONS

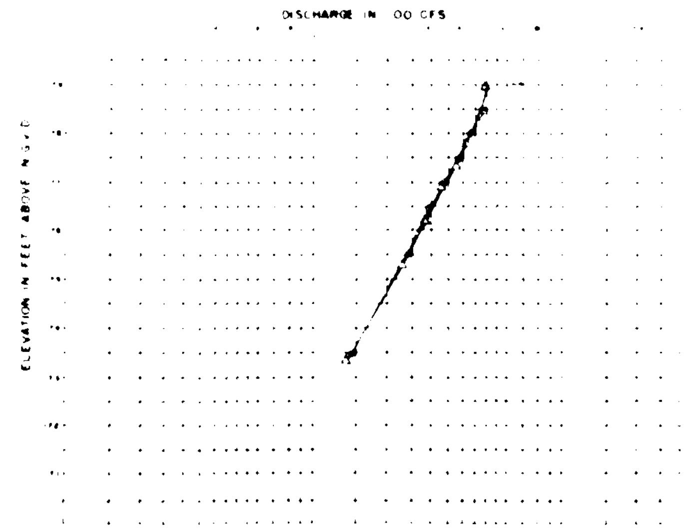
SYMBOL	ZONE	DESCRIPTION	DATE	APPROVED





TION 189+92 (UPSTREAM HARDY STREET)





STATION 214+90

LEGEND

EXISTING CONDITION

PROJECT CONDITION

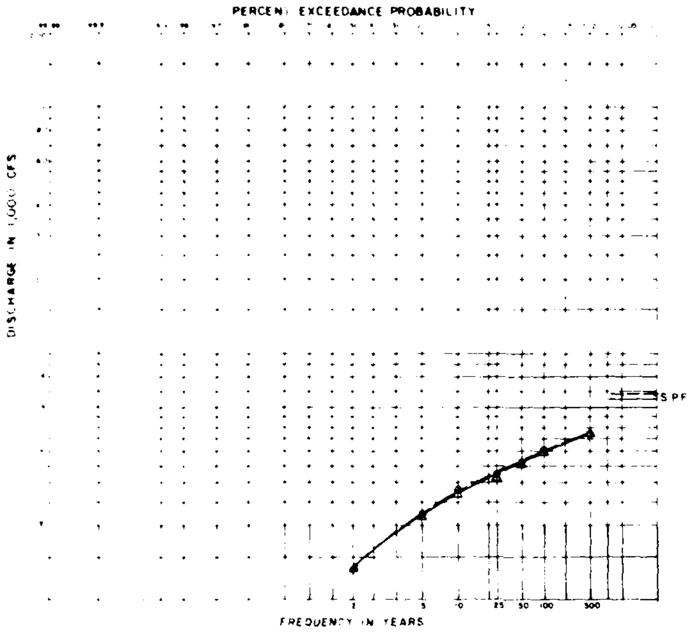
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

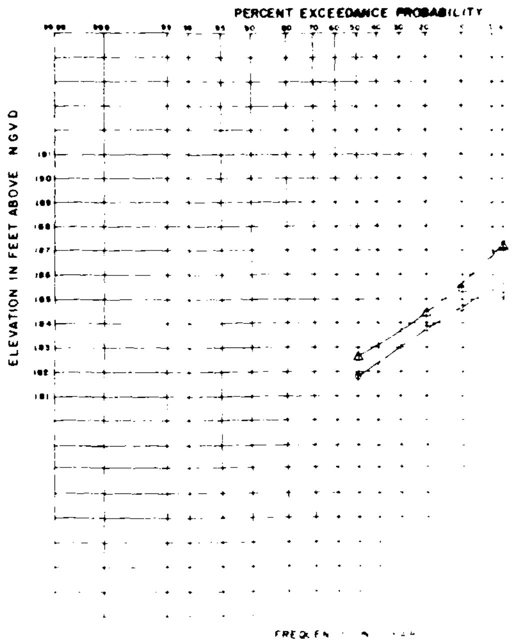
UPPER GORDONS CREEK FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI

DISCHARGE - STAGE - FREQUENCY CURVES

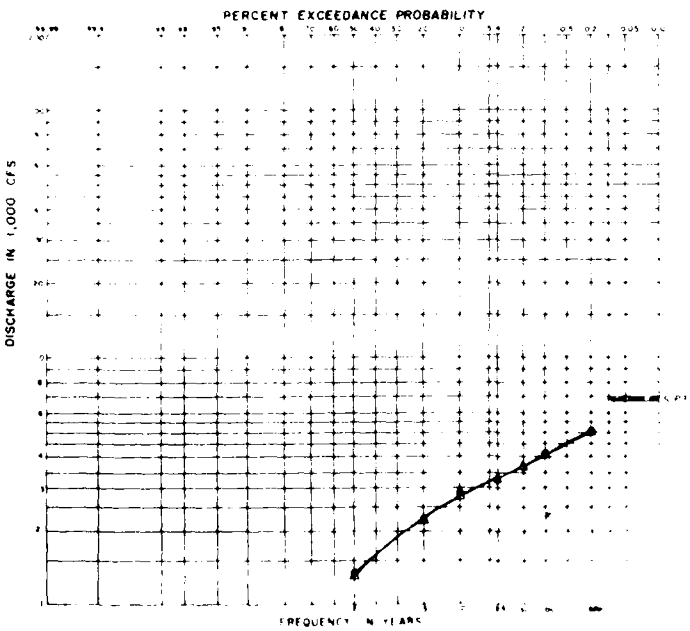
SHEET 2 OF 5

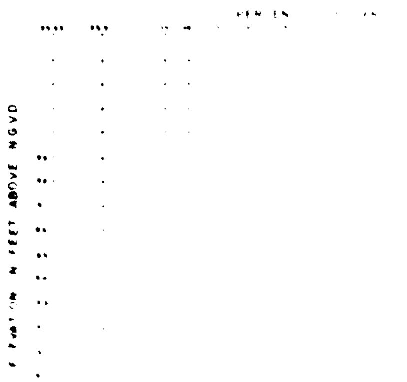
CORPS OF ENGINEERS | 4 | 3





STATION 251+58 (UPSTREAM OF

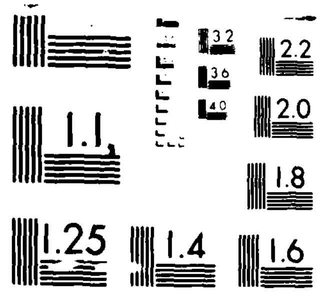




5

AD-A179 191 DETAILED PROJECT REPORT AND ENVIRONMENTAL ASSESSMENT ON 3/5
UPPER GORDONS CRE..(U) CORPS OF ENGINEERS MOBILE AL
MOBILE DISTRICT SEP 86 COESAM/PDW-86/004

UNCLASSIFIED F/G 13/2 NL

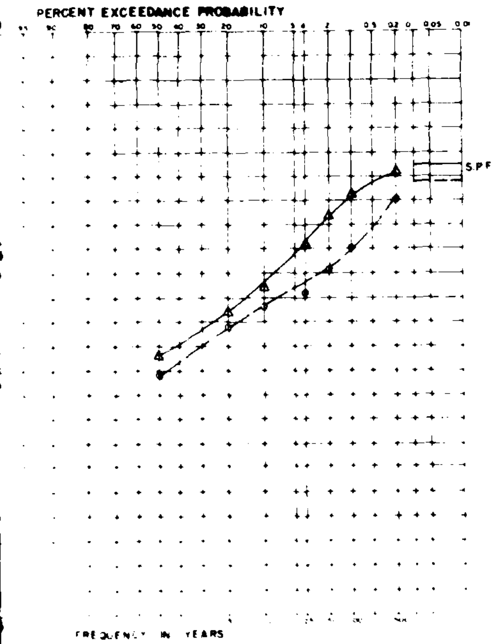


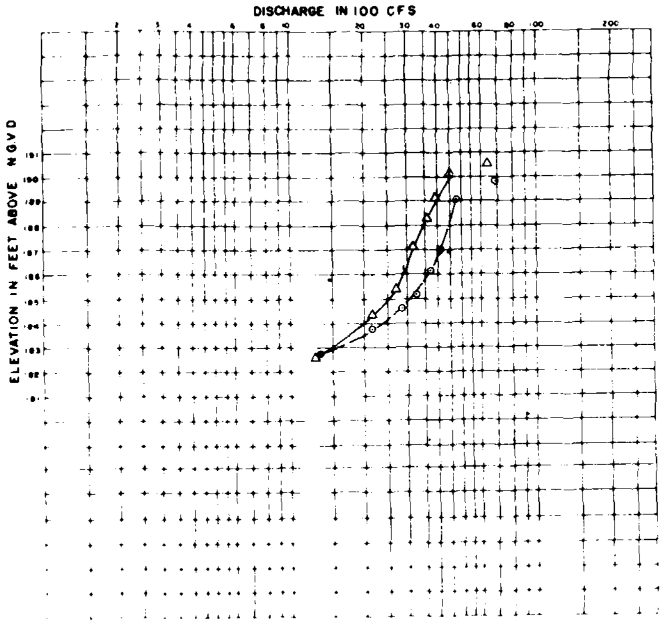
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS

U. S. ARMY

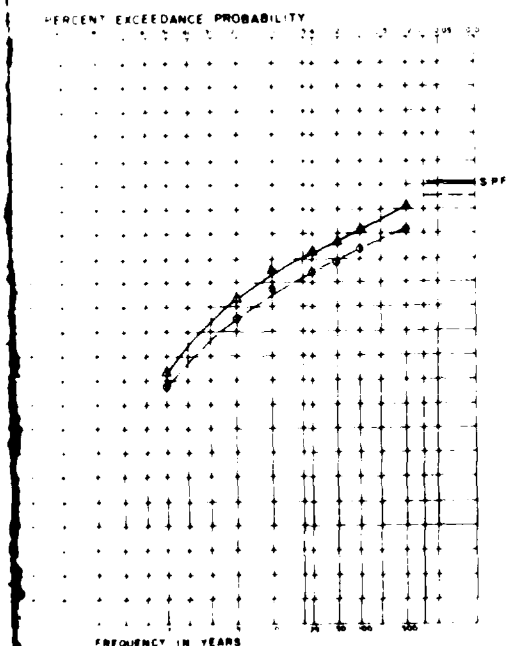
REVISIONS

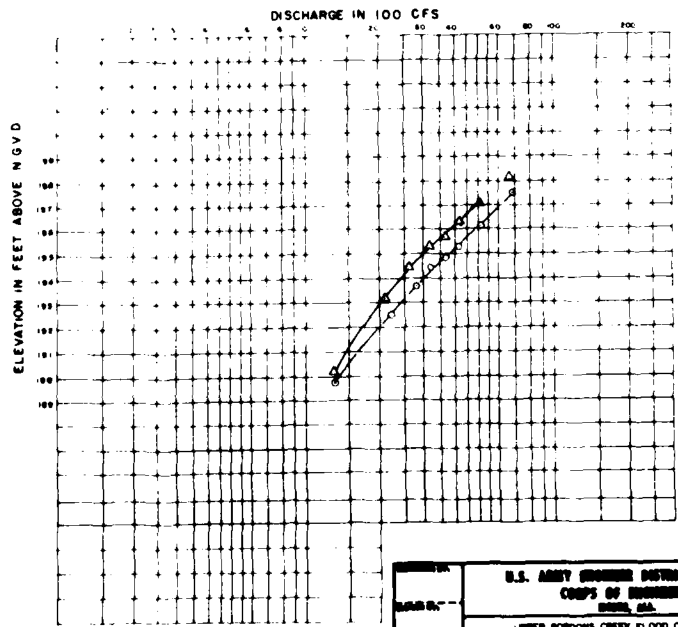
SYM.	ZONE	DESCRIPTION	DATE	APPROVED





251+58 (UPSTREAM OF LOWER HIGHWAY 11)





N 279+55 (UPSTREAM OF HIGHWAY 49)

LEGEND

△———△ EXISTING CONDITION

○— — —○ PROJECT CONDITION

U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

UPPER GORDONS CREEK FLOOD CONTROL STUDY

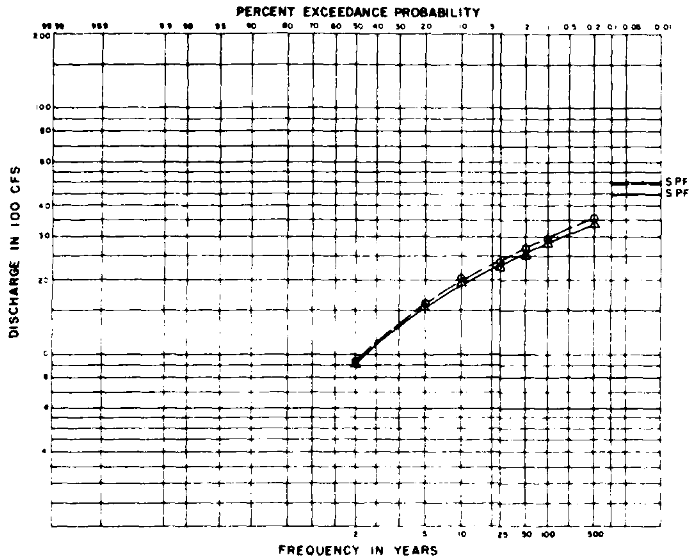
HATTIESBURG, MISSISSIPPI

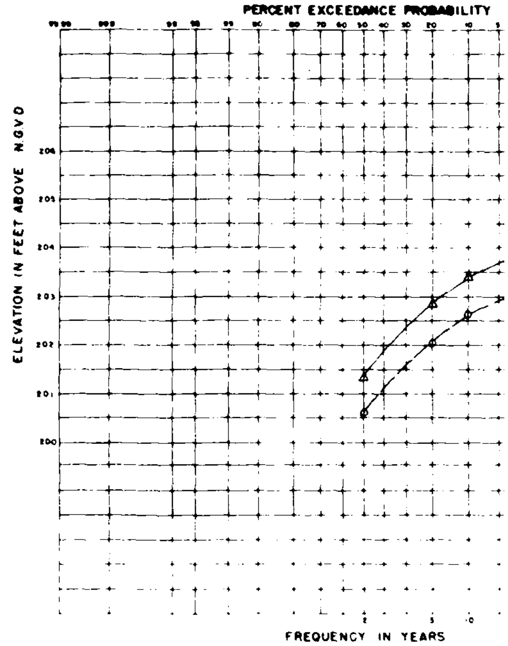
DISCHARGE - STAGE - FREQUENCY CURVES

SHEET 3 OF 3

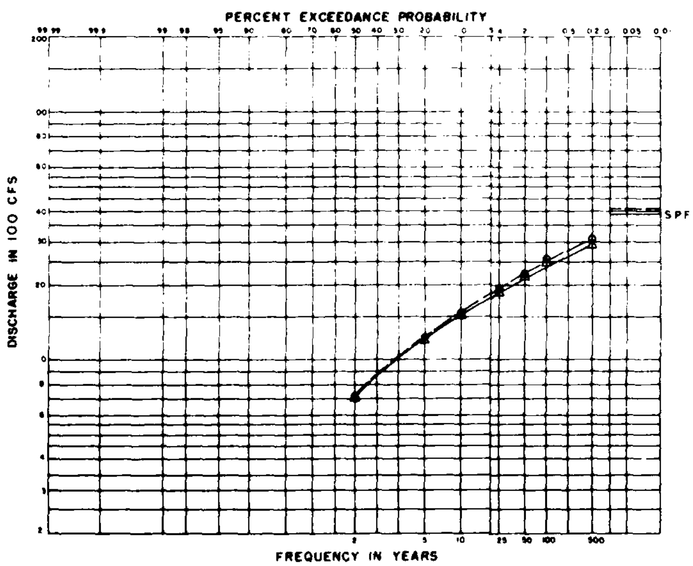
APPENDIX 2, CHART NO. 2-C-8

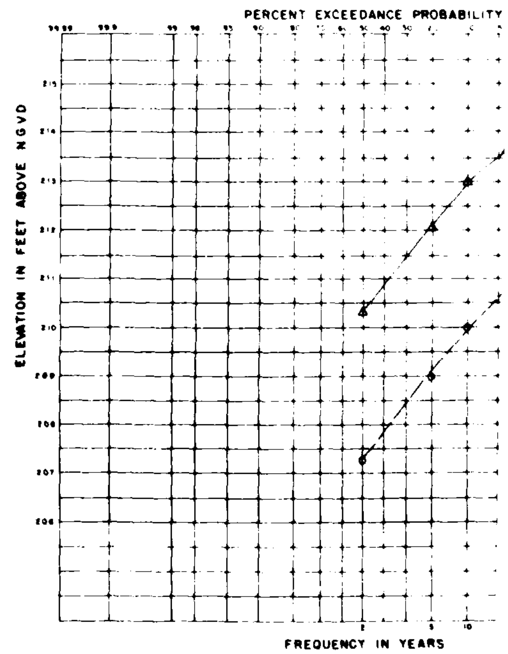
CORPS OF ENGINEERS | 4 | 3





STATION 316+90 (UPSTREAM OF HIGHW





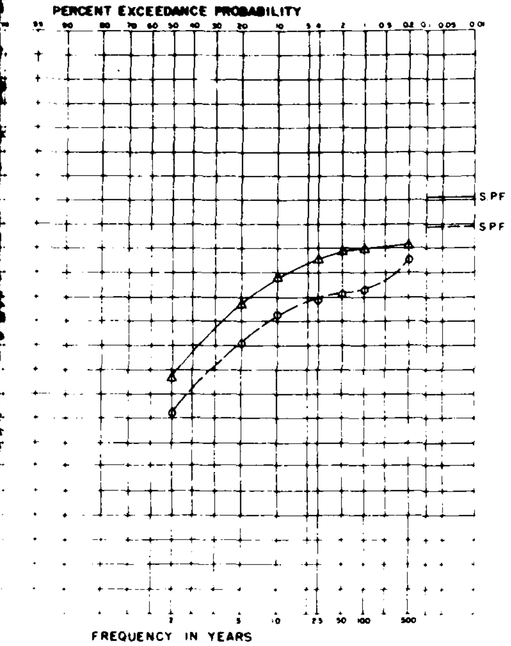
STATION 343+04 (APPROXIMATELY 600' UPSTREA

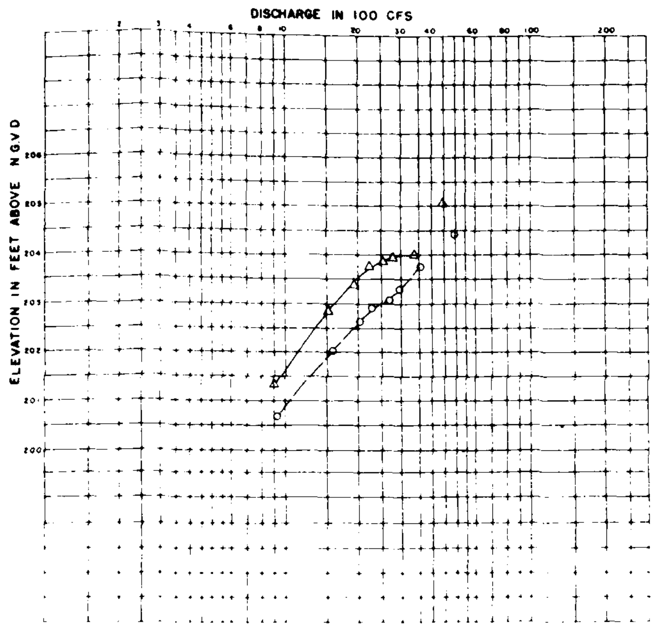
5 | 4 | 3

U. S. ARMY

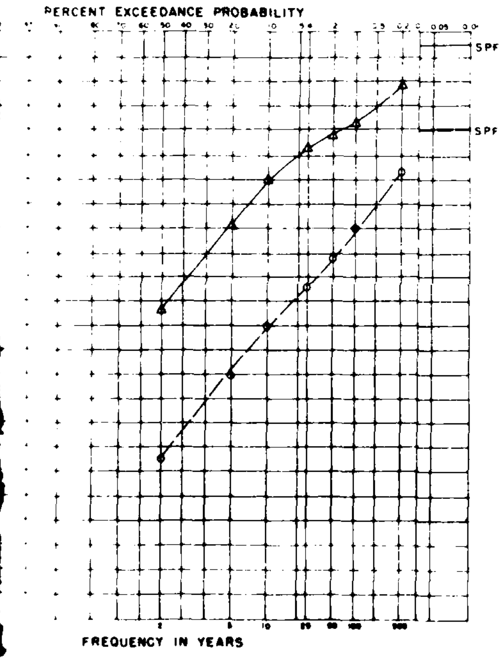
REVISIONS

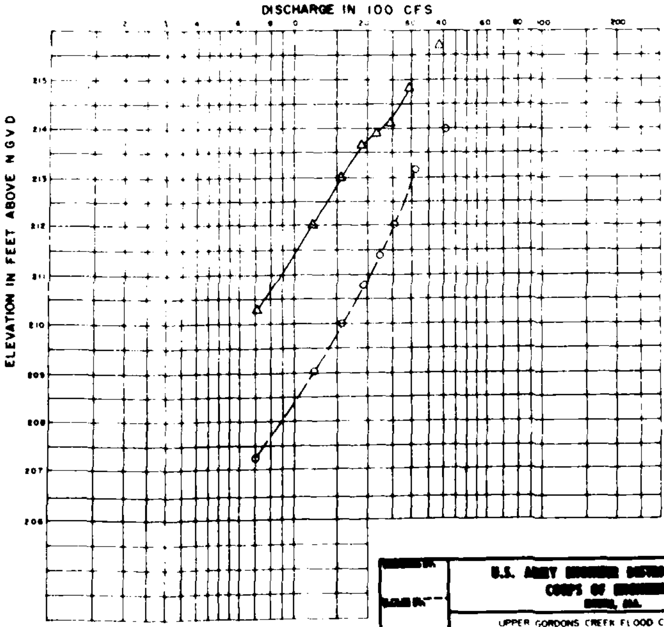
[illegible]	[illegible]	DESCRIPTION	DATE	APPROVED





ON 316+90 (UPSTREAM OF HIGHWAY 11)





4 (APPROXIMATELY 600' UPSTREAM OF 28TH AVENUE)

LEGEND

△———△ EXISTING CONDITION

○— — —○ PROJECT CONDITION

U.S. ARMY [illegible] DISTRICT, MOBILE

CORPS OF [illegible]

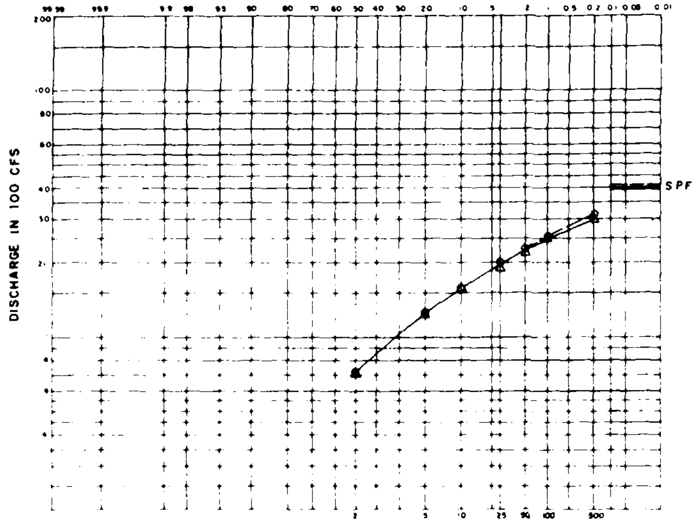
UPPER GORDONS CREEK FLOOD CONTROL STUDY

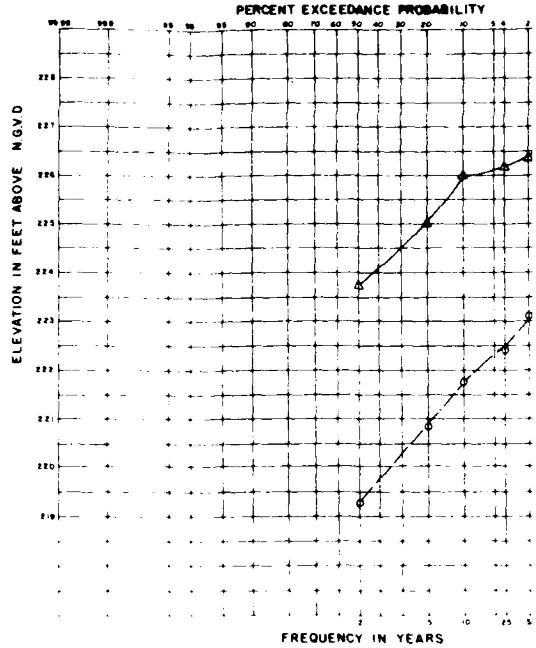
HATTIESBURG, MISSISSIPPI

DISCHARGE - STAGE - FREQUENCY CURVES

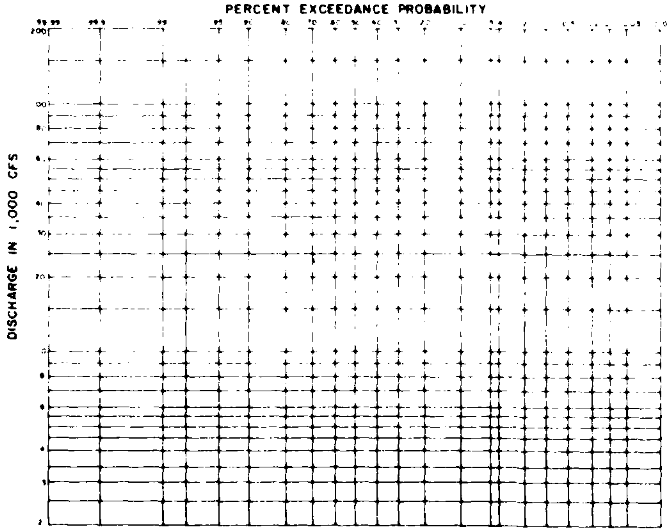
SHEET 4 OF 5

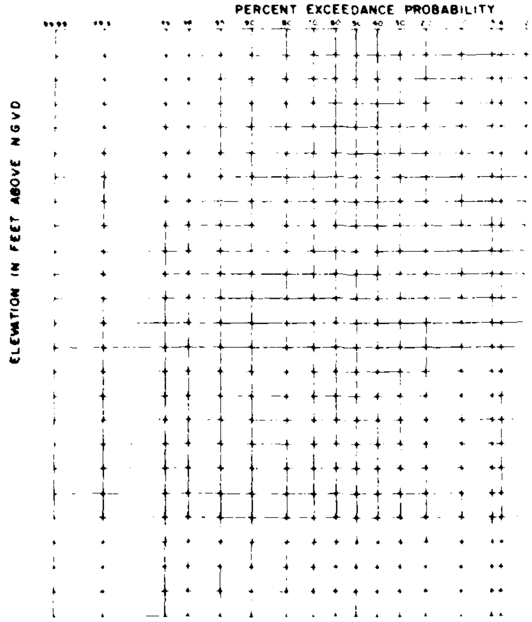
APPENDIX 2, CHART NO 2-C-9





STATION 375+78

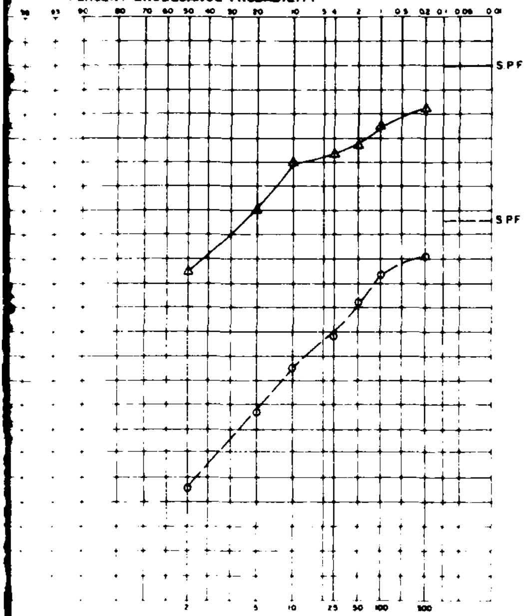




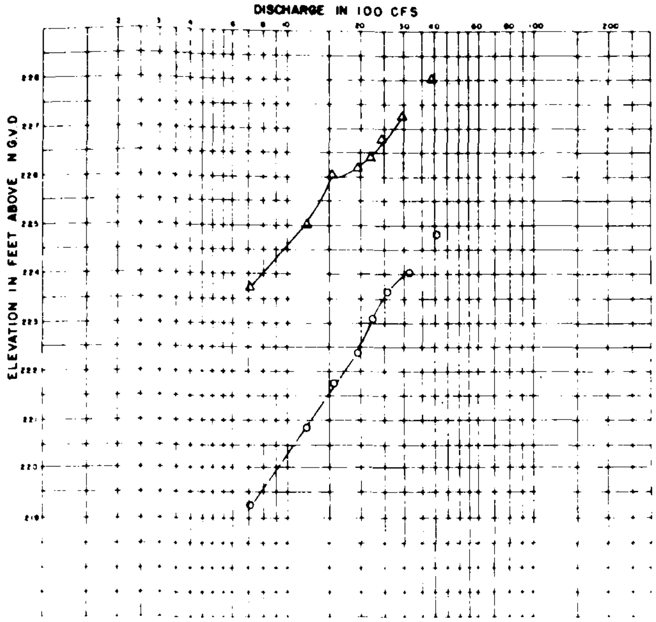
3	2	1	U. S. ARMY

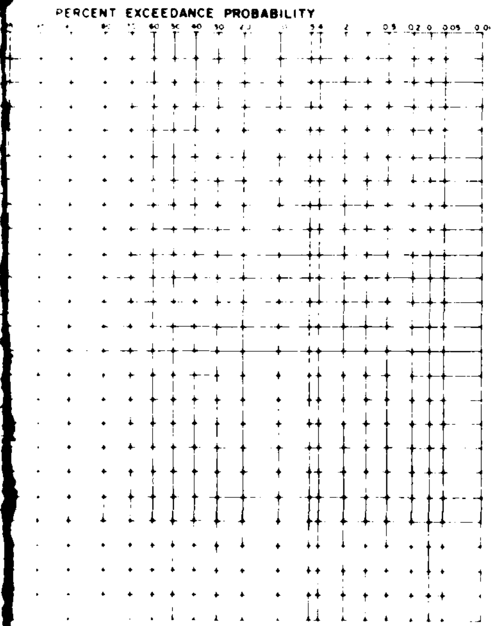
REVISIONS

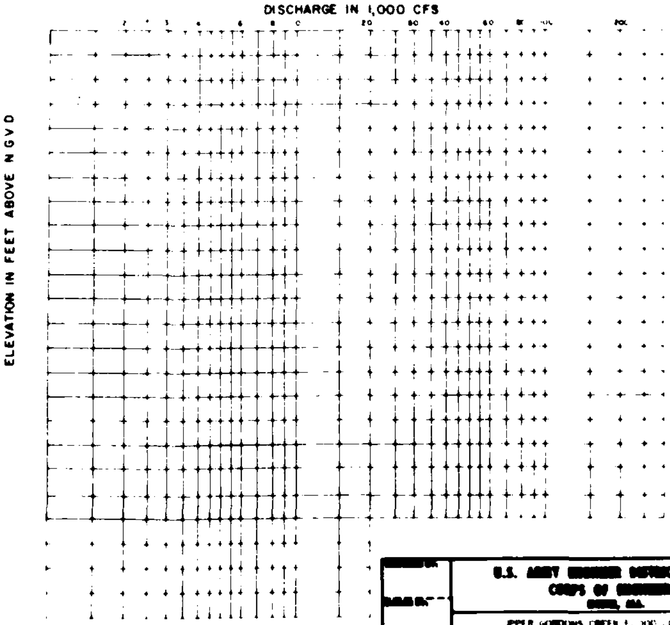
SYM.	ZONE	DESCRIPTION	DATE	APPROVED



STATION 375+78







LEGEND

Δ———Δ EXISTING CONDITION

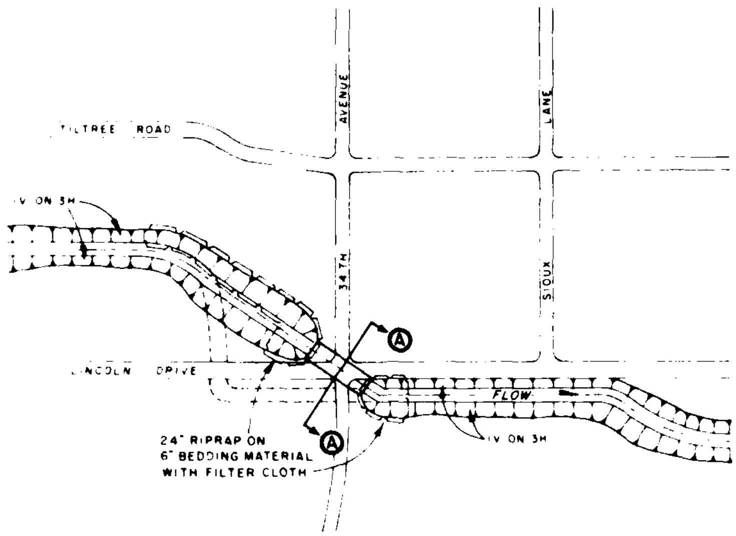
O———O PROJECT CONDITION

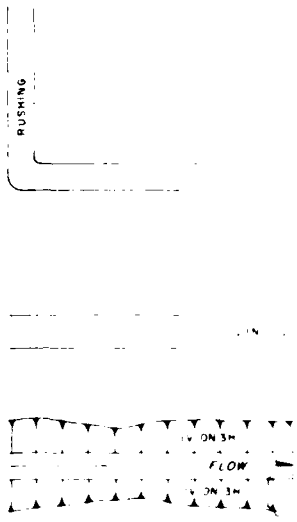
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

UPPER GORDONS CREEK FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI

DISCHARGE - STAGE - FREQUENCY CURVES

3	2	APPENDIX 2, CHART NO 2-C-10

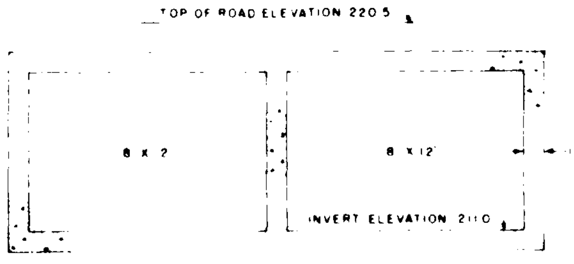




BRIDGE MODIFICATION AT 34 TH AVENUE AND LINCOLN DRIVE

SCALE IN FEET

BR



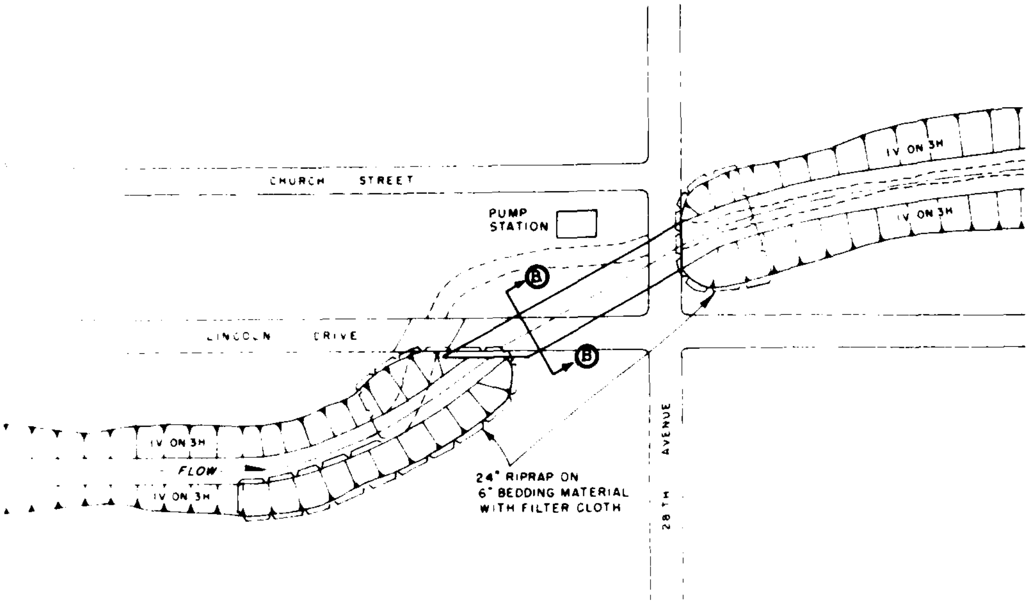
SECTION A-A

SCALE IN FEET

3	2	1	U. S. ARMY

REVISIONS

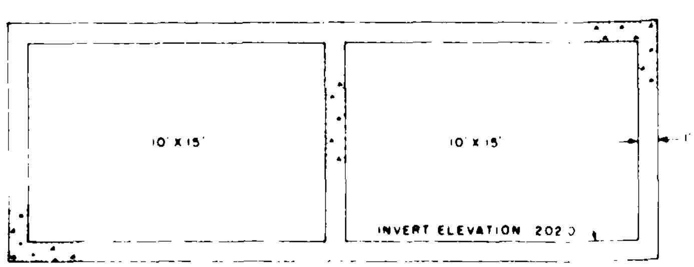
SYM	ZONE	DESCRIPTION	DATE	APPROVED



BRIDGE MODIFICATION AT 28 TH AVENUE AND LINCOLN DRIVE

SCALE IN FEET 50 0 50 100

TOP OF ROAD ELEVATION 213.5



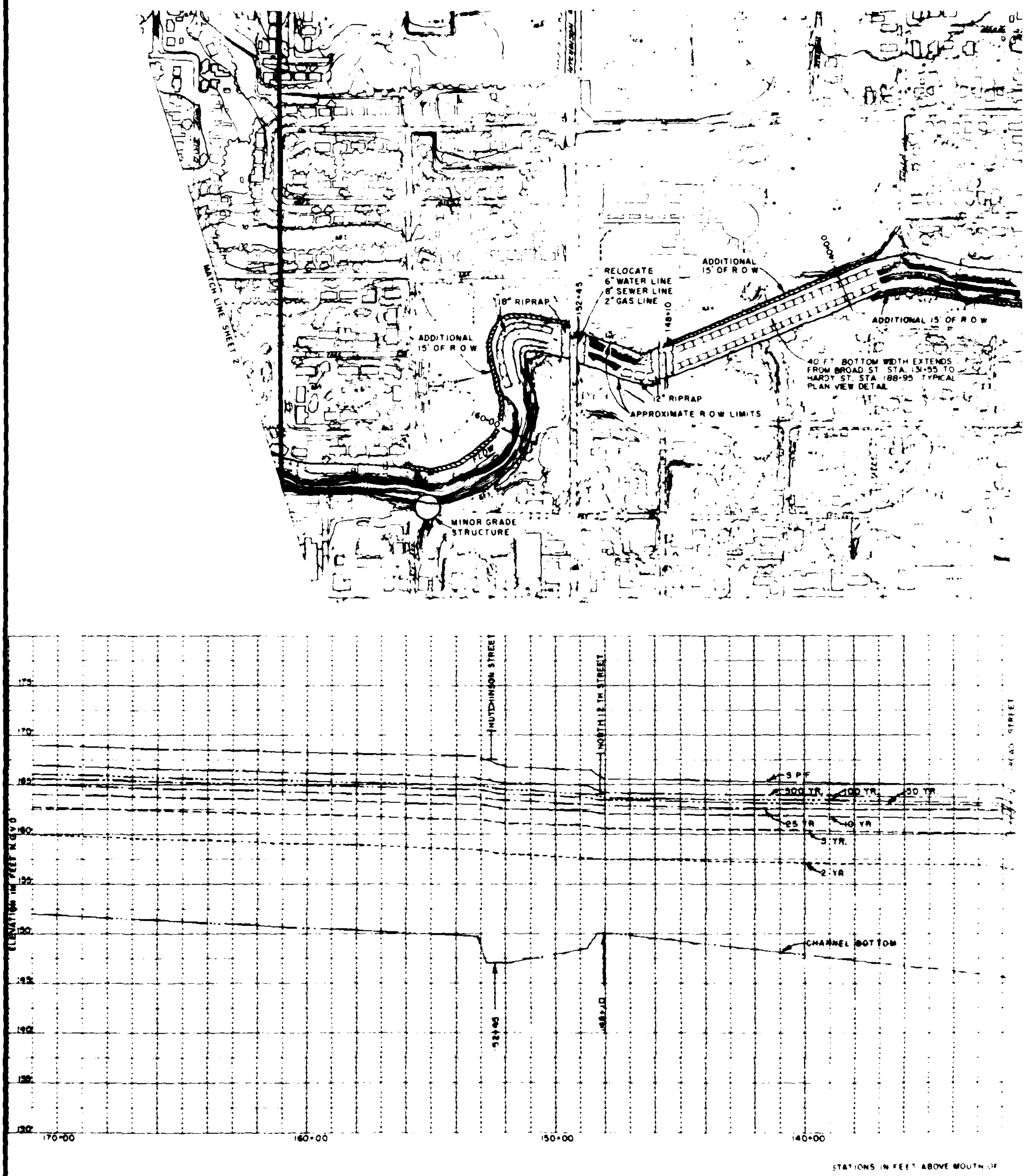
SECTION B-B

SCALE IN FEET

U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

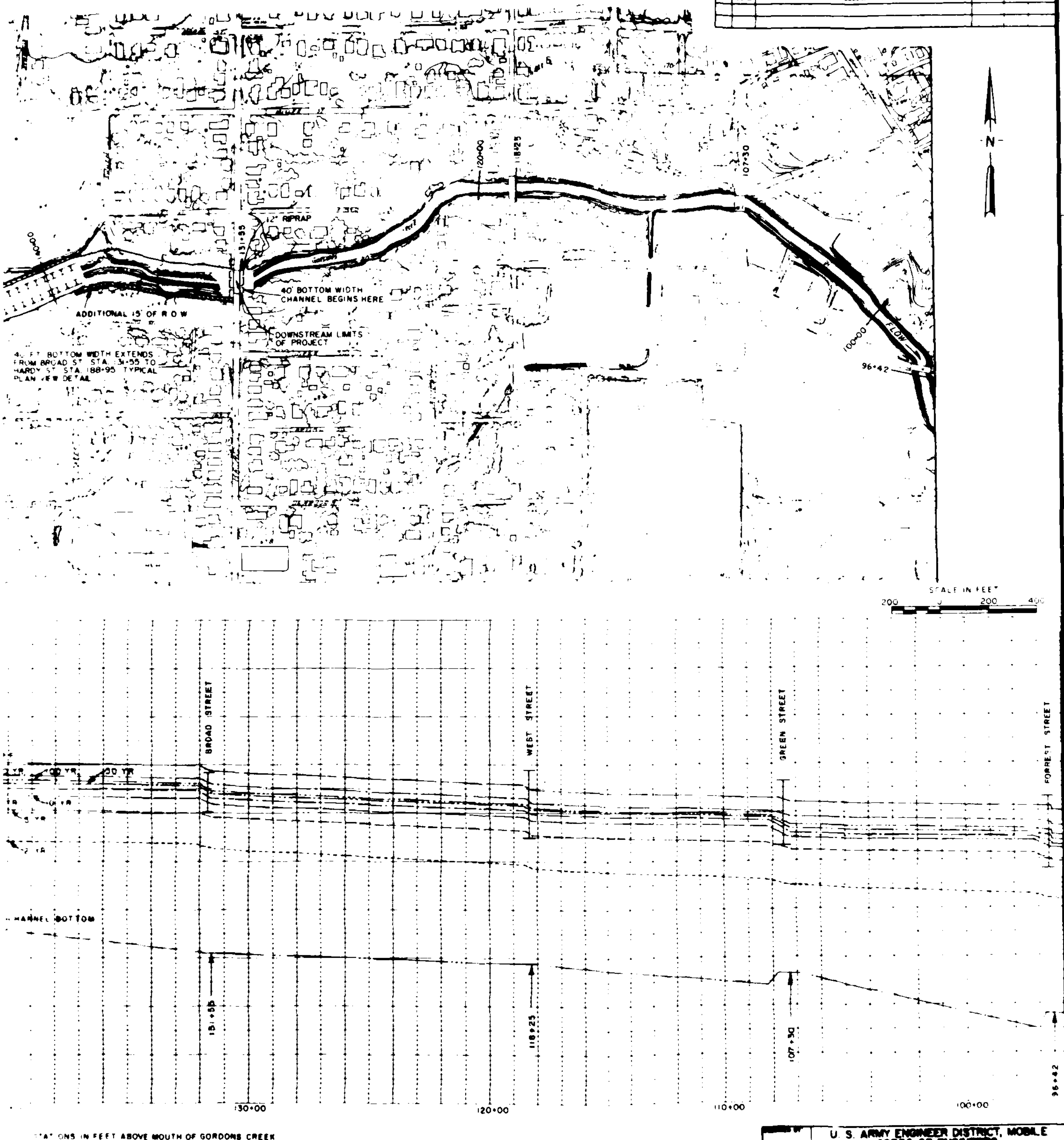
HATTIESBURG, MISSISSIPPI
CHANNEL REALIGNMENT AND
BRIDGE MODIFICATIONS

3	2


MATCH LINE SHEET 2
RELOCATE
6" WATER LINE
8" SEWER LINE
2" GAS LINE
ADDITIONAL
15' OF R O W
18" RIPRAP
152+45
148+10
ADDITIONAL
15' OF R O W
ADDITIONAL 15' OF R O W
40 FT. BOTTOM WIDTH EXTENDS
FROM BROAD ST. STA. 131+55 TO
HARDY ST. STA. 188+95. TYPICAL
PLAN VIEW DETAIL
12" RIPRAP
APPROXIMATE R O W LIMITS
160+00
FLOW
MINOR GRADE
STRUCTURE
HUTCHINSON STREET
NORTH 12 TH STREET
S P F
500 YR.
100 YR.
50 YR.
25 YR.
10 YR.
5 YR.
2 YR.
CHANNEL BOTTOM
ELEVATION IN FEET N.G.V.D.
175
170
165
160
155
150
145
140
135
130
170+00
160+00
150+00
140+00
STATIONS IN FEET ABOVE MOUTH OF

3 | 2 | 1 | U. S. ARMY

REVISIONS				
SYM.	ZONE	DESCRIPTION	DATE	APPROVED



U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA

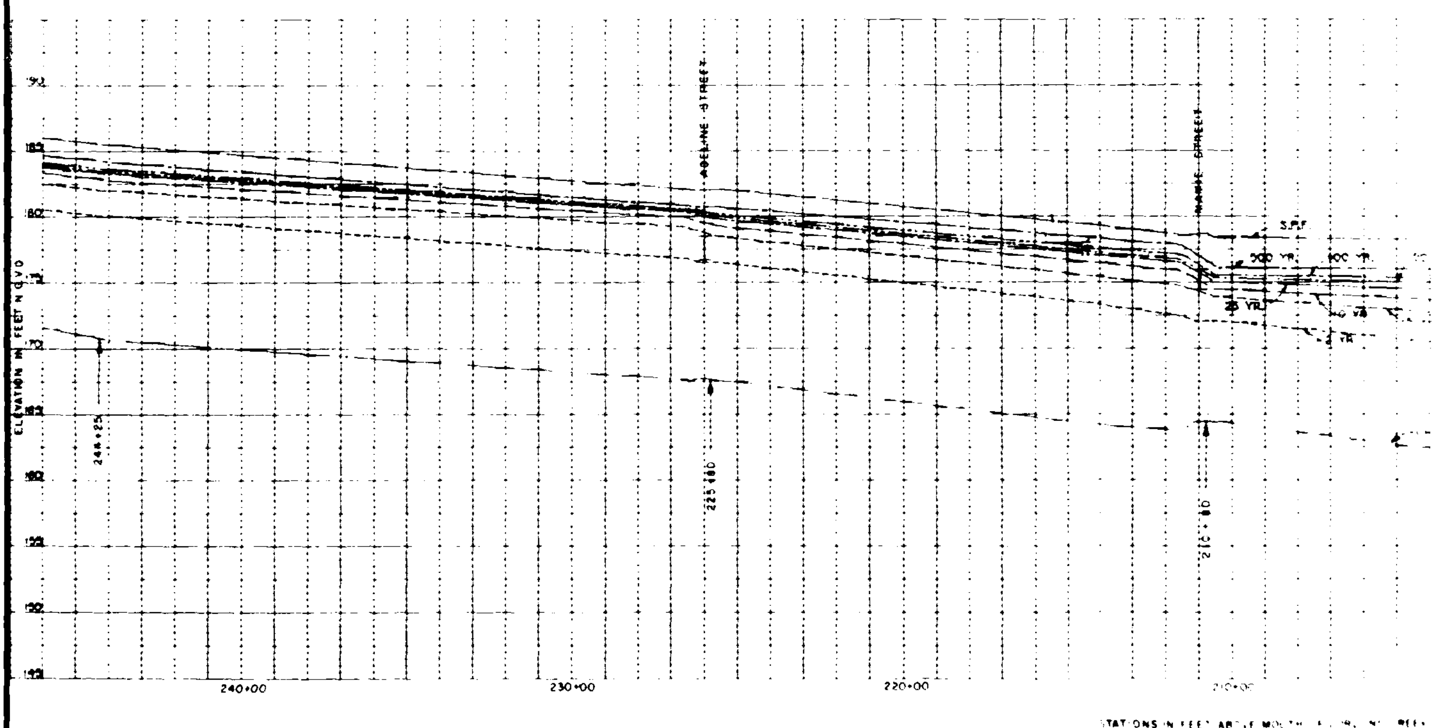
HATTIESBURG, MISSISSIPPI

FLOOD FREQUENCY PROFILES
PROJECT CONDITIONS

DESIGNED BY | DRAWN BY | CHECKED BY | SUBMITTED BY | SH REF NO | SPEC NO | FILE NO | DRAWING NO | SCALE | DATE | SHEET

3 | 2

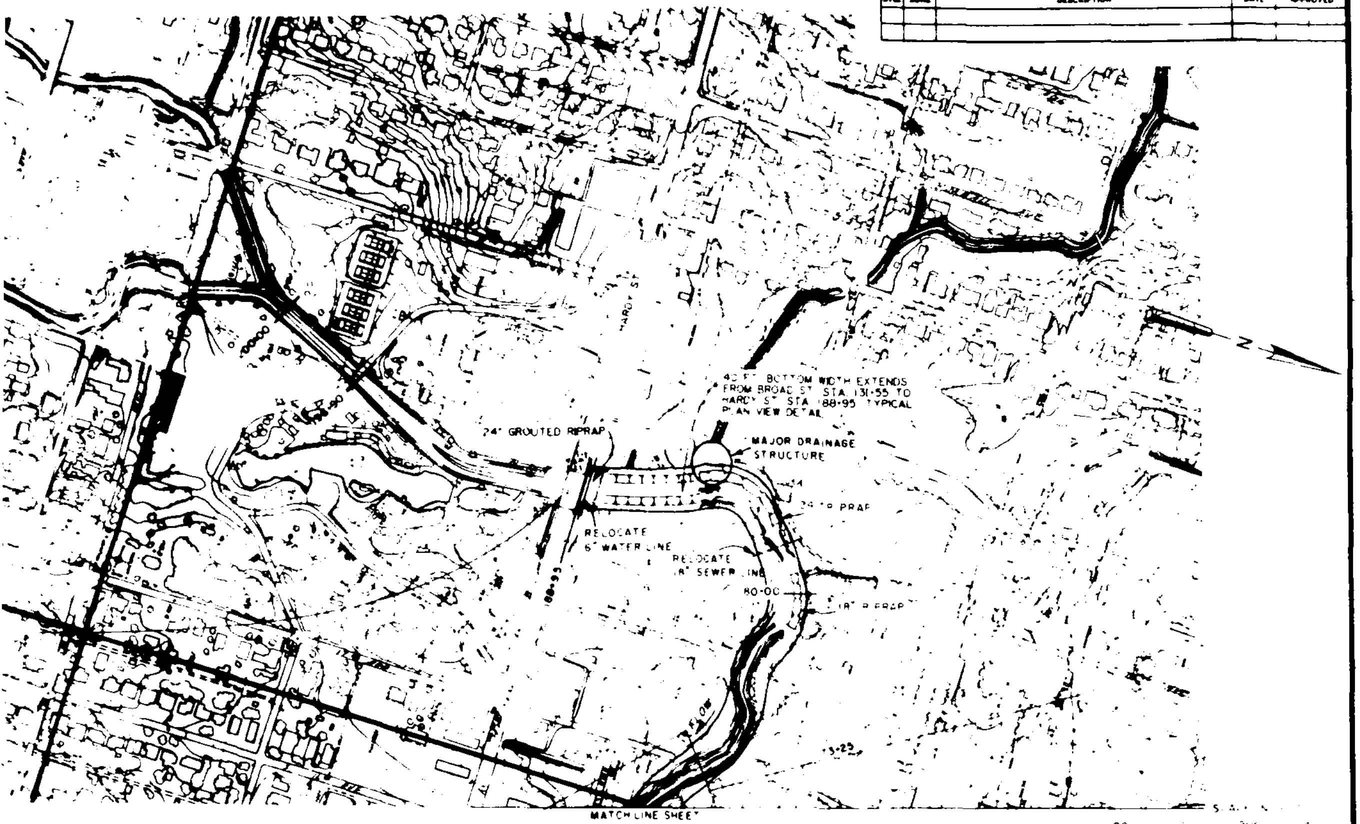
CORPS OF ENGINEERS | 4 | 3

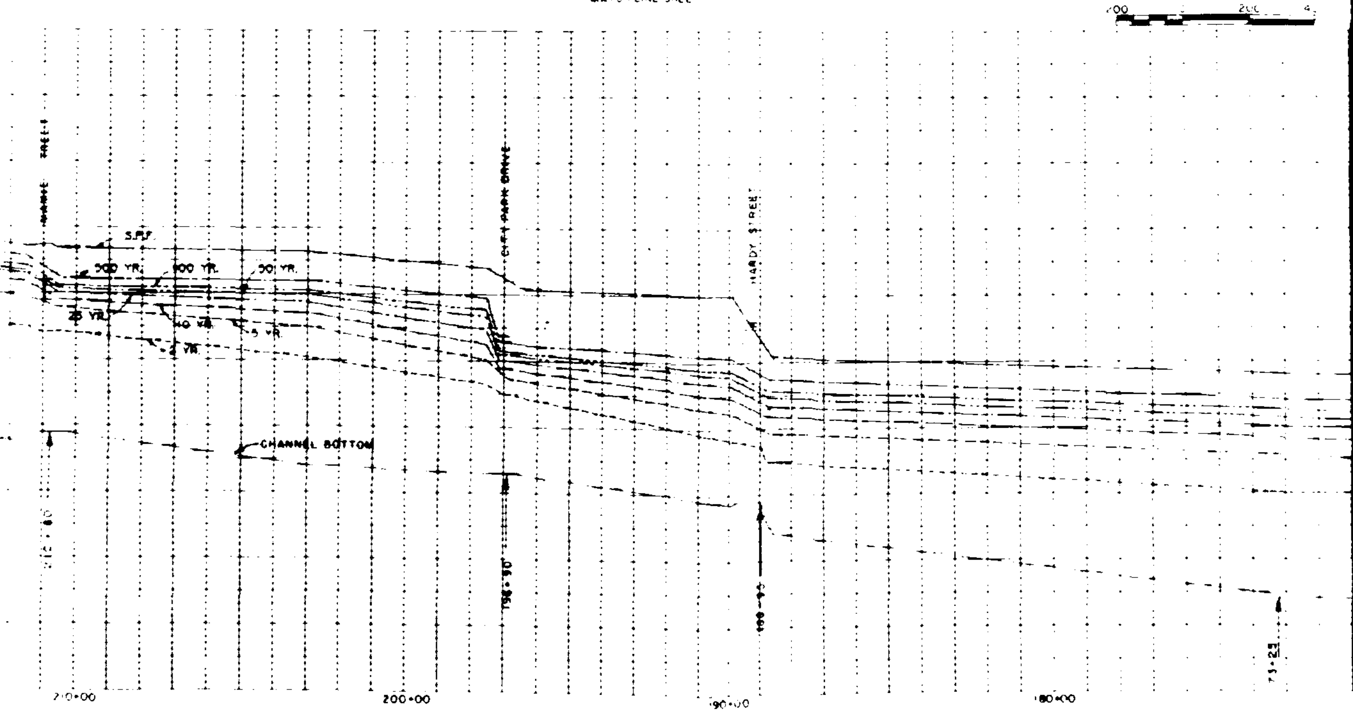


5 | 4 | 3

REVISIONS

SYMBOL	ZONE	DESCRIPTION	DATE	APPROVED



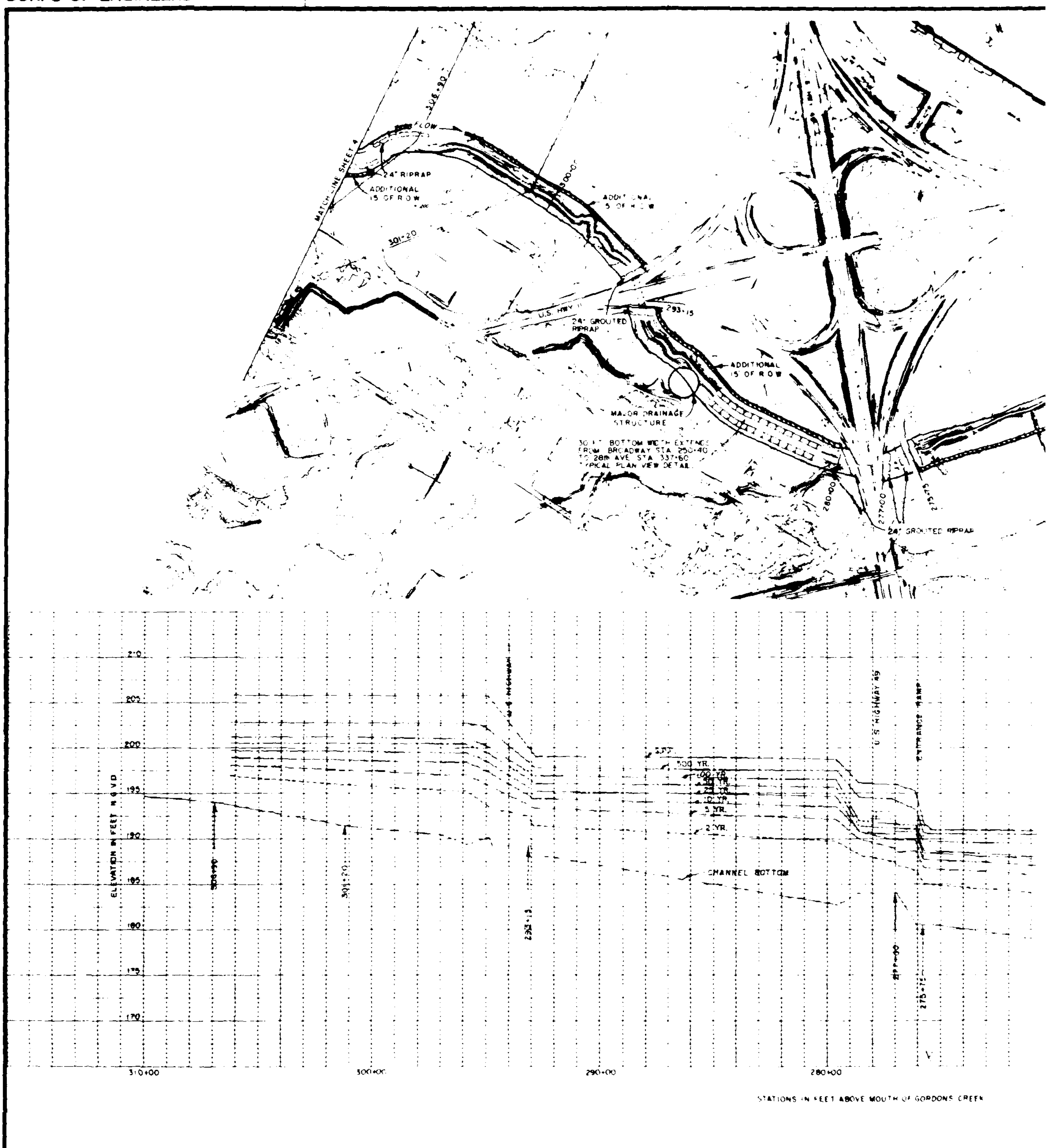


FEET ABOVE MOUTH OF GORDONS CREEK

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA

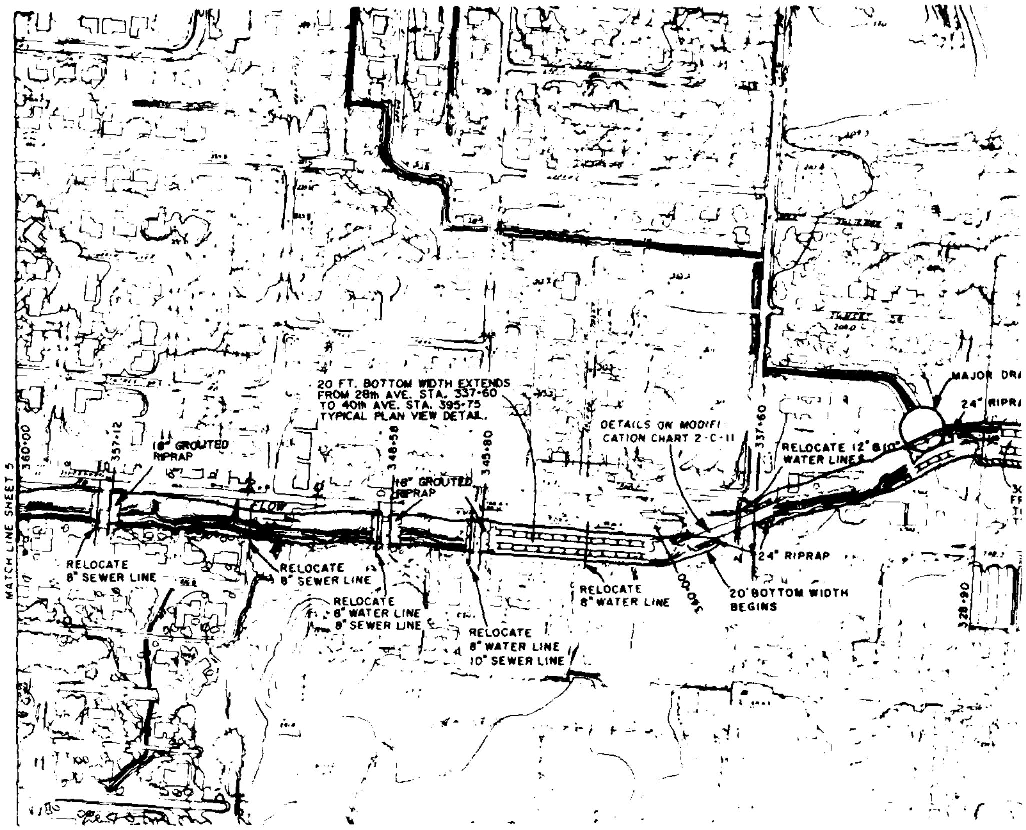
HATTIESBURG, MISSISSIPPI

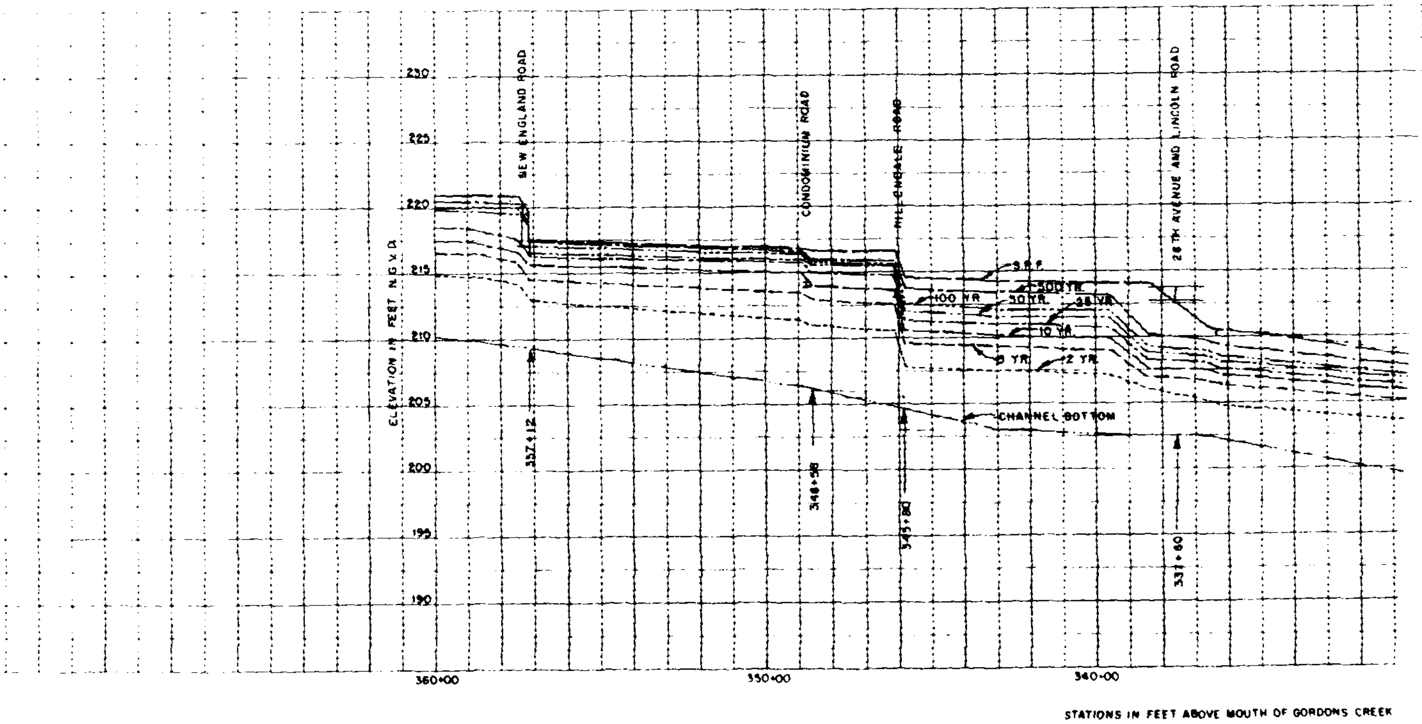
FLOOD FREQUENCY PROFILES
PROJECT CONDITIONS


MATCH LINE SHEET 4
305+90
FLOW
24" RIPRAP
ADDITIONAL
15' OF R.O.W.
300+00
301+20
U.S. HWY
24" GROUTED
RIPRAP
293+15
ADDITIONAL
15' OF R.O.W.
MAJOR DRAINAGE
STRUCTURE
280+00
277+00
24" GROUTED RIPRAP
500 YR.
100 YR.
50 YR.
25 YR.
10 YR.
5 YR.
2 YR.
CHANNEL BOTTOM
U.S. HIGHWAY 49
ENTRANCE RAMP
ELEVATION IN FEET N.G.V.D.
210
205
200
195
190
185
180
175
170
310+00
300+00
290+00
280+00
STATIONS IN FEET ABOVE MOUTH OF GORDONS CREEK

CORPS OF ENGINEERS

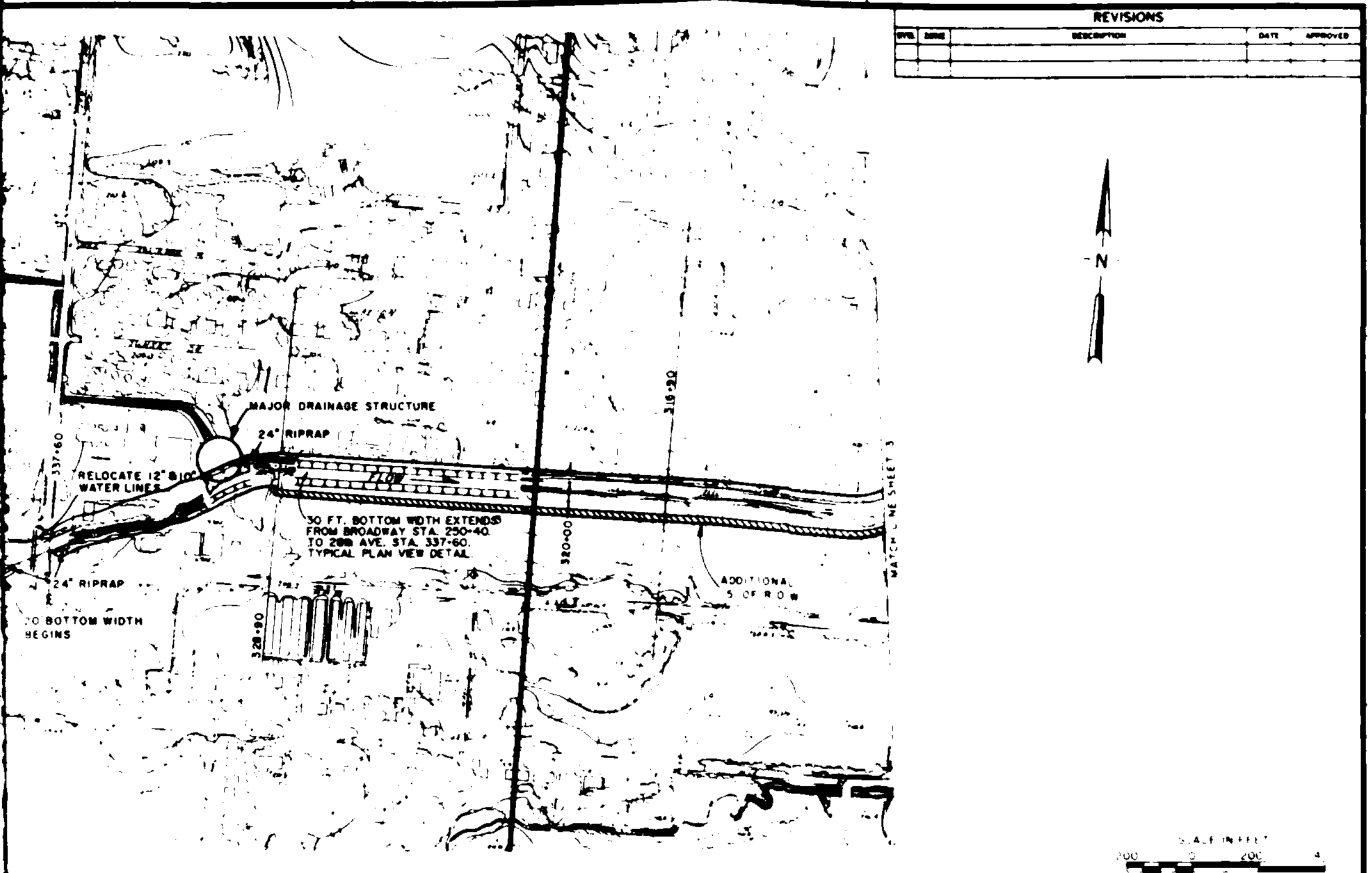
	4	3

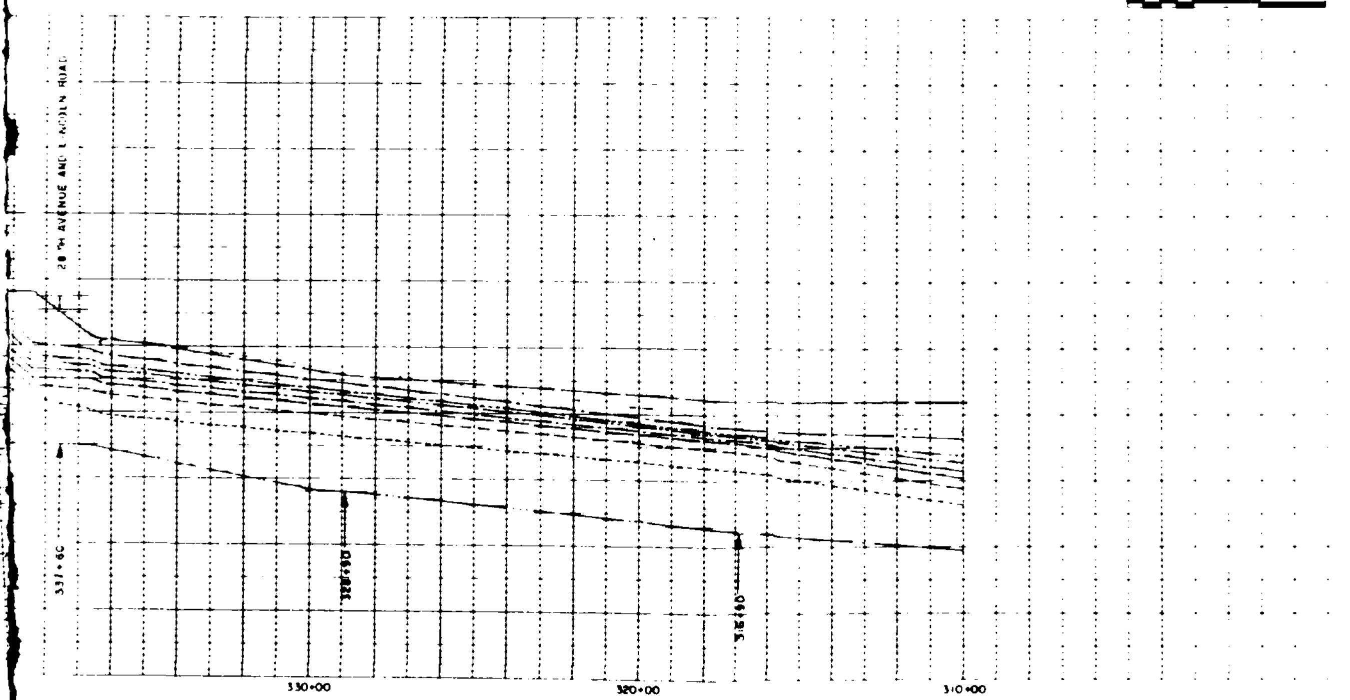




5	4	3

U. S. ARMY





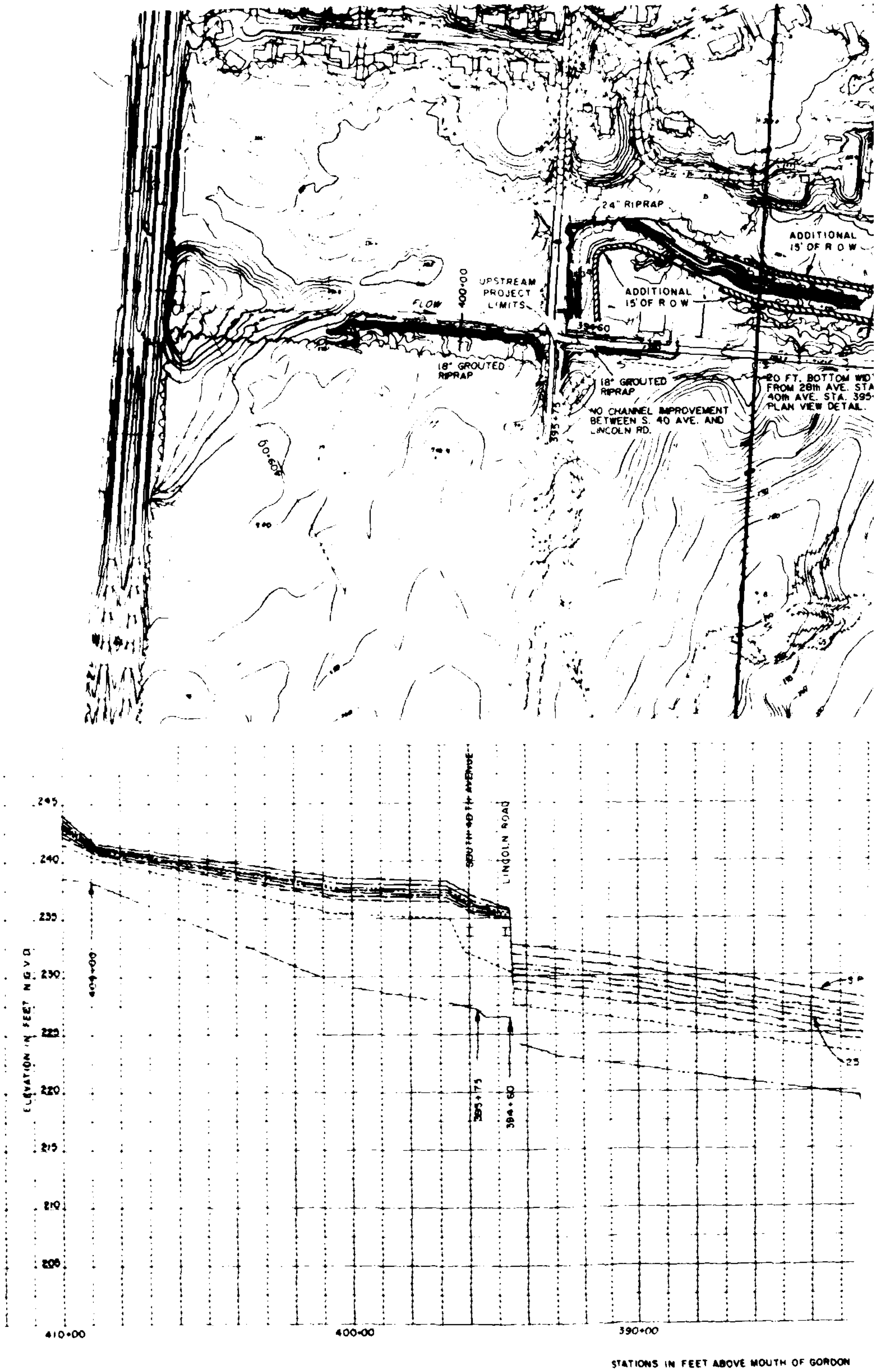
U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA

HATTIESBURG, MISSISSIPPI

FLOOD FREQUENCY PROFILES
PROJECT CONDITIONS

CORPS OF ENGINEERS

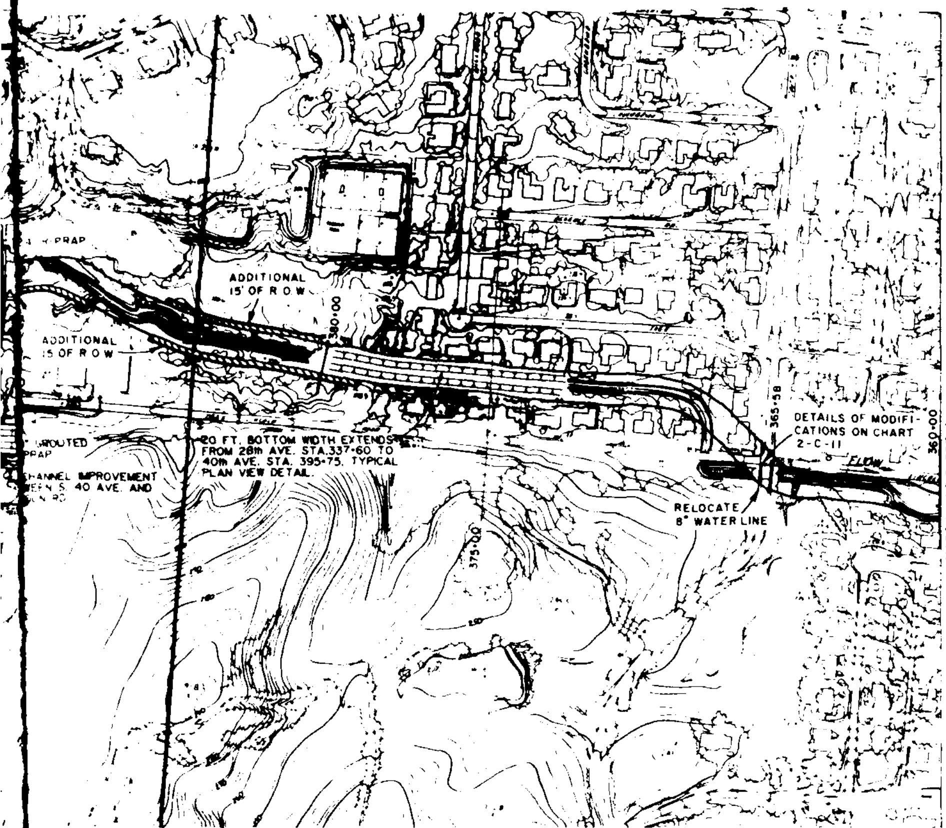
4 3

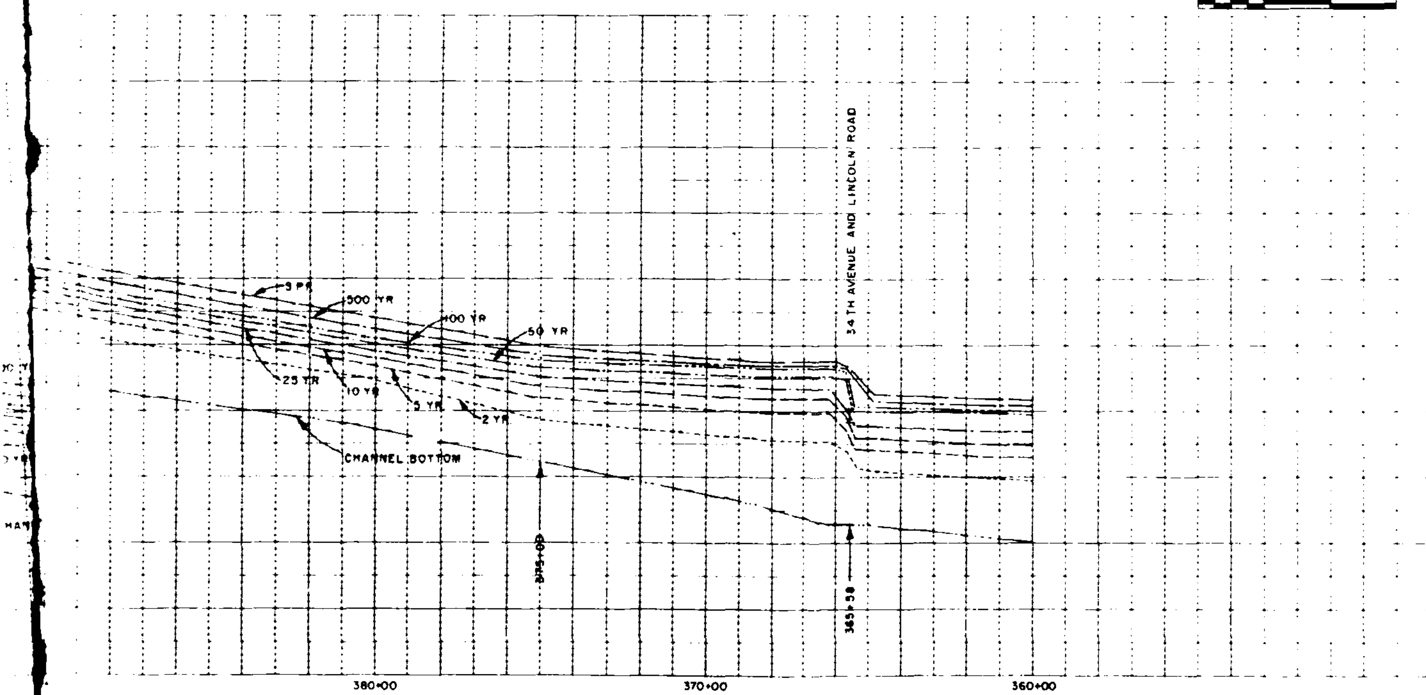


5 4 3

U. S. ARMY

REVISIONS				
SYM.	ZONE	DESCRIPTION	DATE	APPROVED





U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

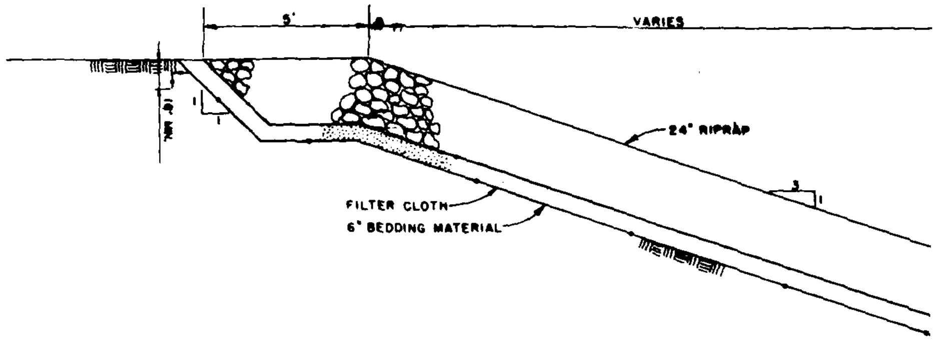
UPPER GORDONS CREEK FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI

FLOOD FREQUENCY PROFILES
PROJECT CONDITIONS

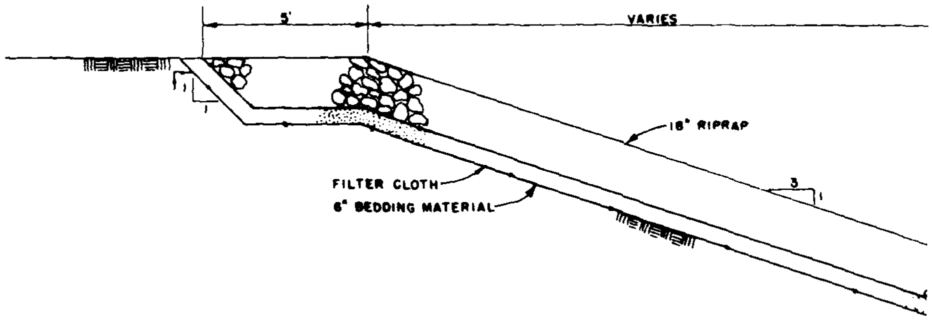
SHEET 5 OF 5

APPENDIX 2, CHART NO. 2-C-16

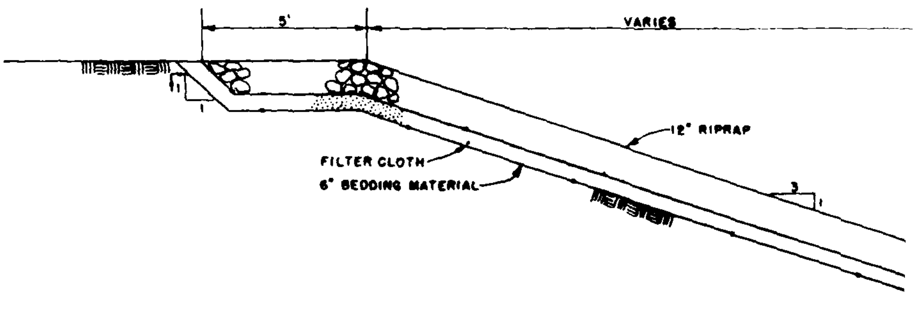
CORPS OF ENGINEERS | 4 | 3



TYPICAL 24" RIPRAP SECTION
NOT TO SCALE



TYPICAL 18" RIPRAP SECTION
NOT TO SCALE

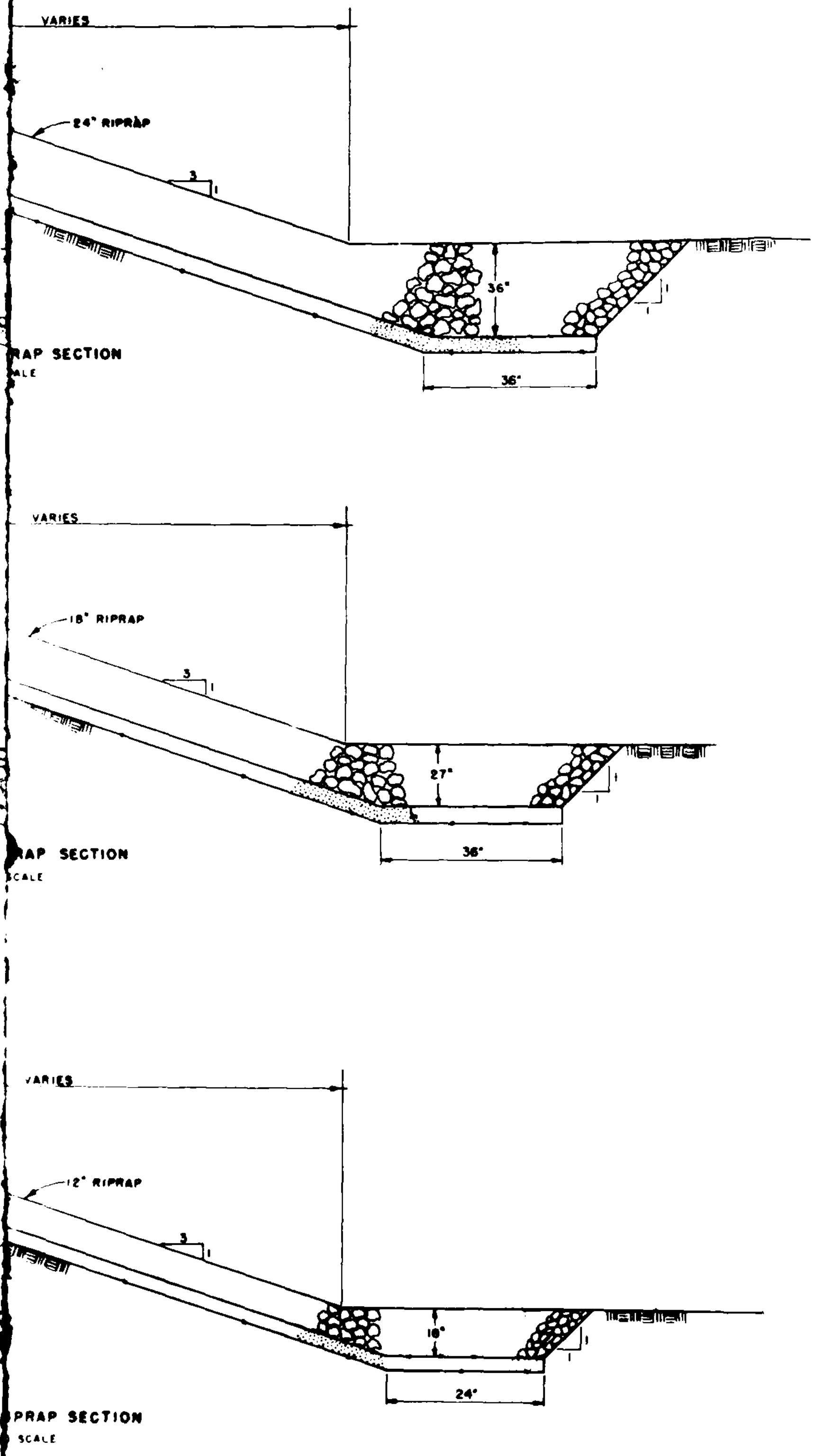


TYPICAL 12" RIPRAP SECTION
NOT TO SCALE

5 | 4 | 3

REVISIONS

SYM.	ZONE	DESCRIPTION	DATE	APPROVED



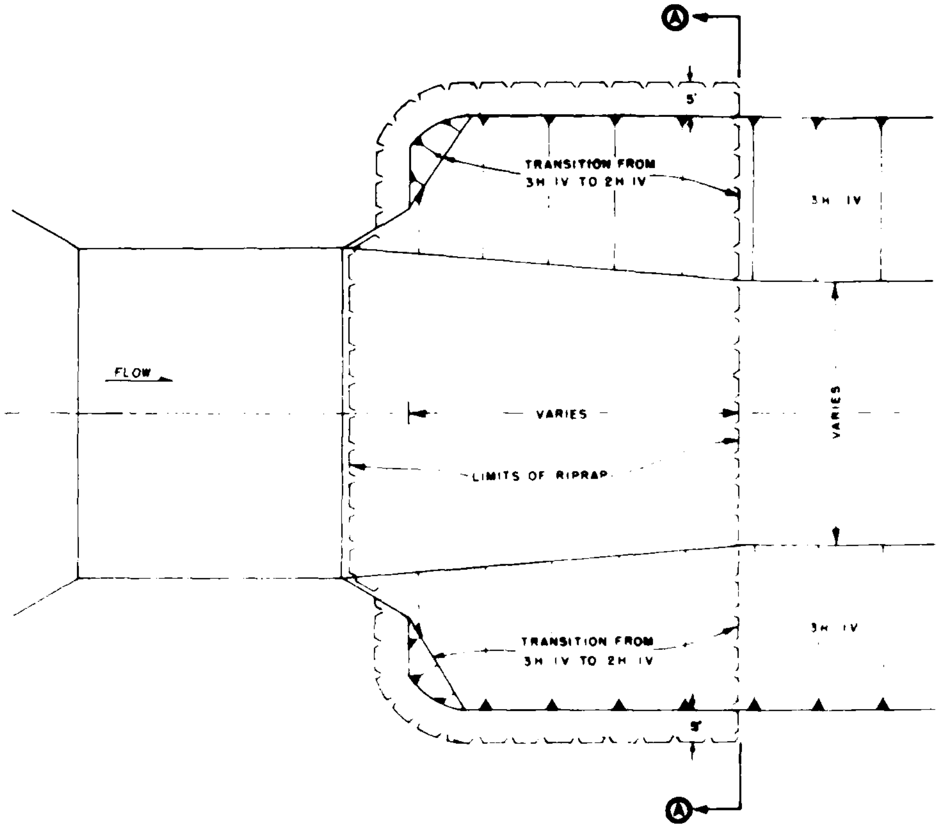
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

UPPER GORDONS CREEK FLOOD CONTROL STUDY

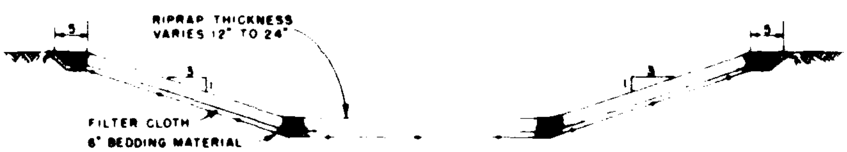
HATTIESBURG, MISSISSIPPI

RIPRAP DETAIL

APPENDIX 2, CHART NO. 2-C-17



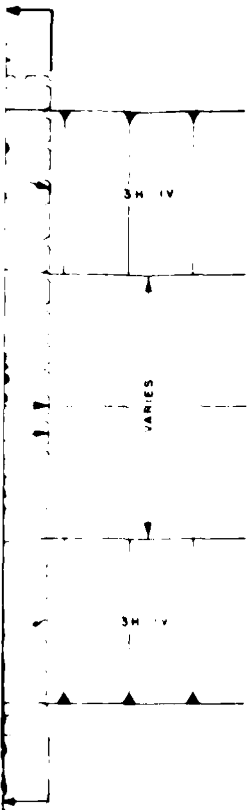
TYPICAL TRANSITION AT BRIDGE CULVERT
NOT TO SCALE

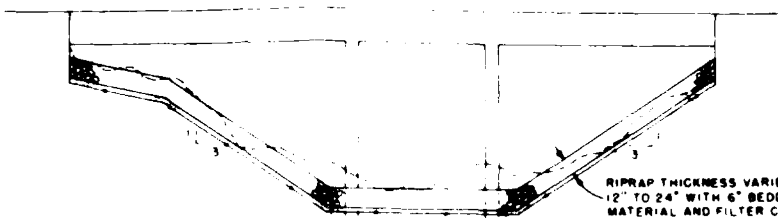


SECTION A-A
NOT TO SCALE

U. S. ARMY

REVISIONS





TYPICAL BRIDGE PROTECTION

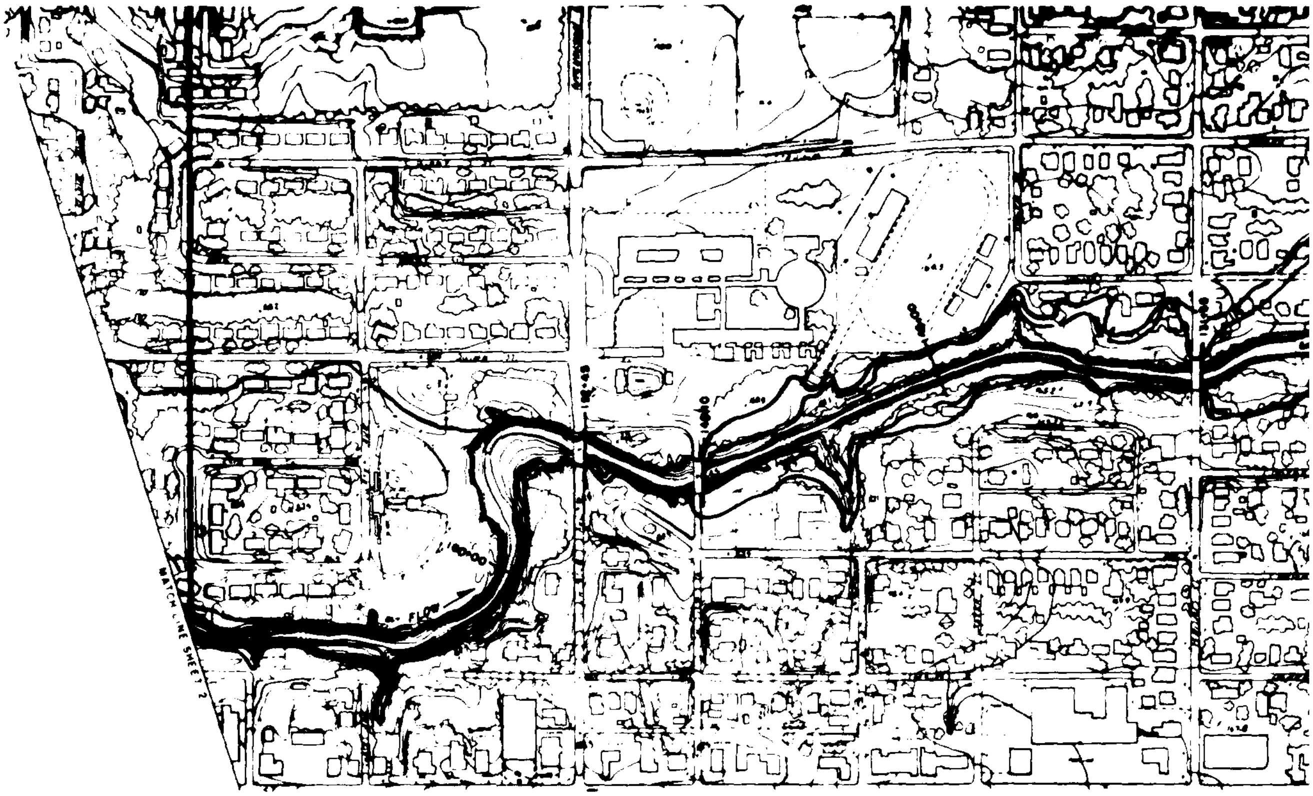
HATTIESBURG

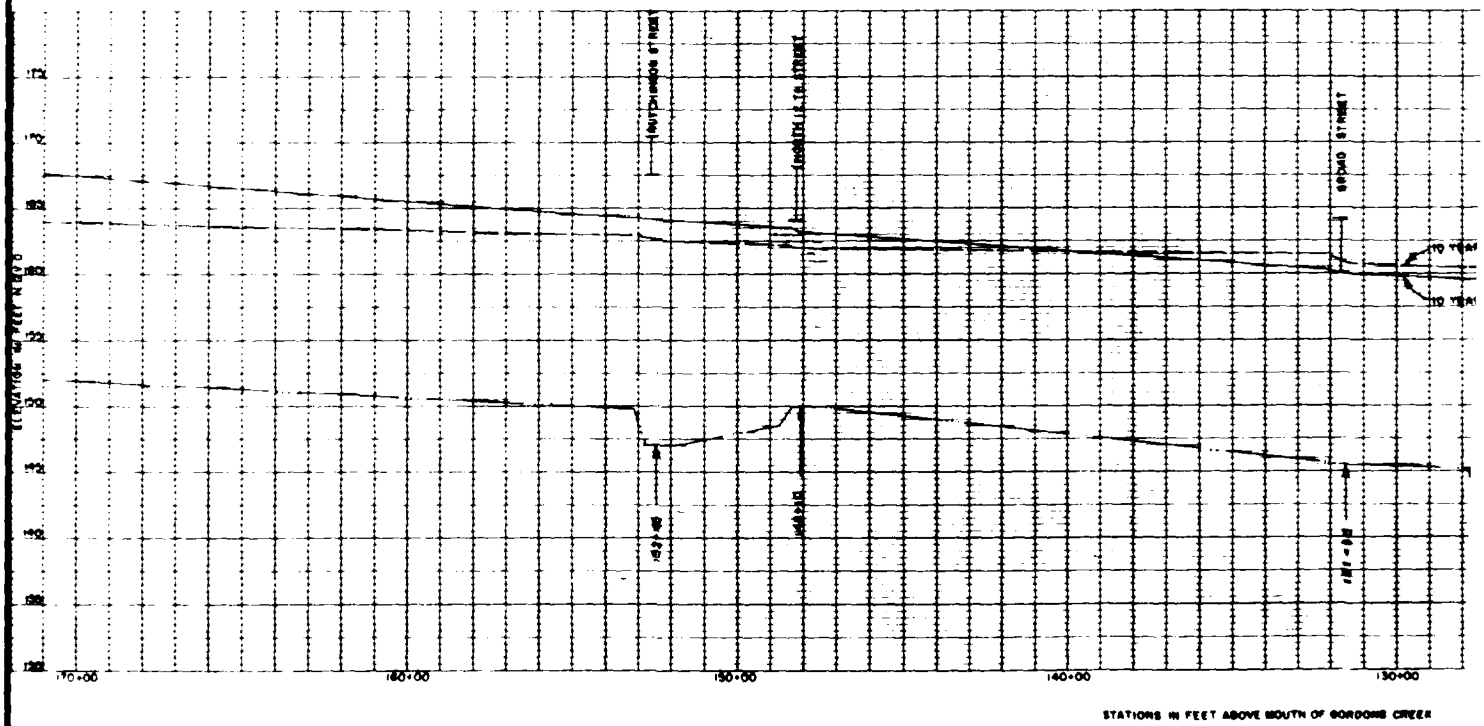
CULVERT AND BRIDGE PROTECTION

CORPS OF ENGINEERS

4

3





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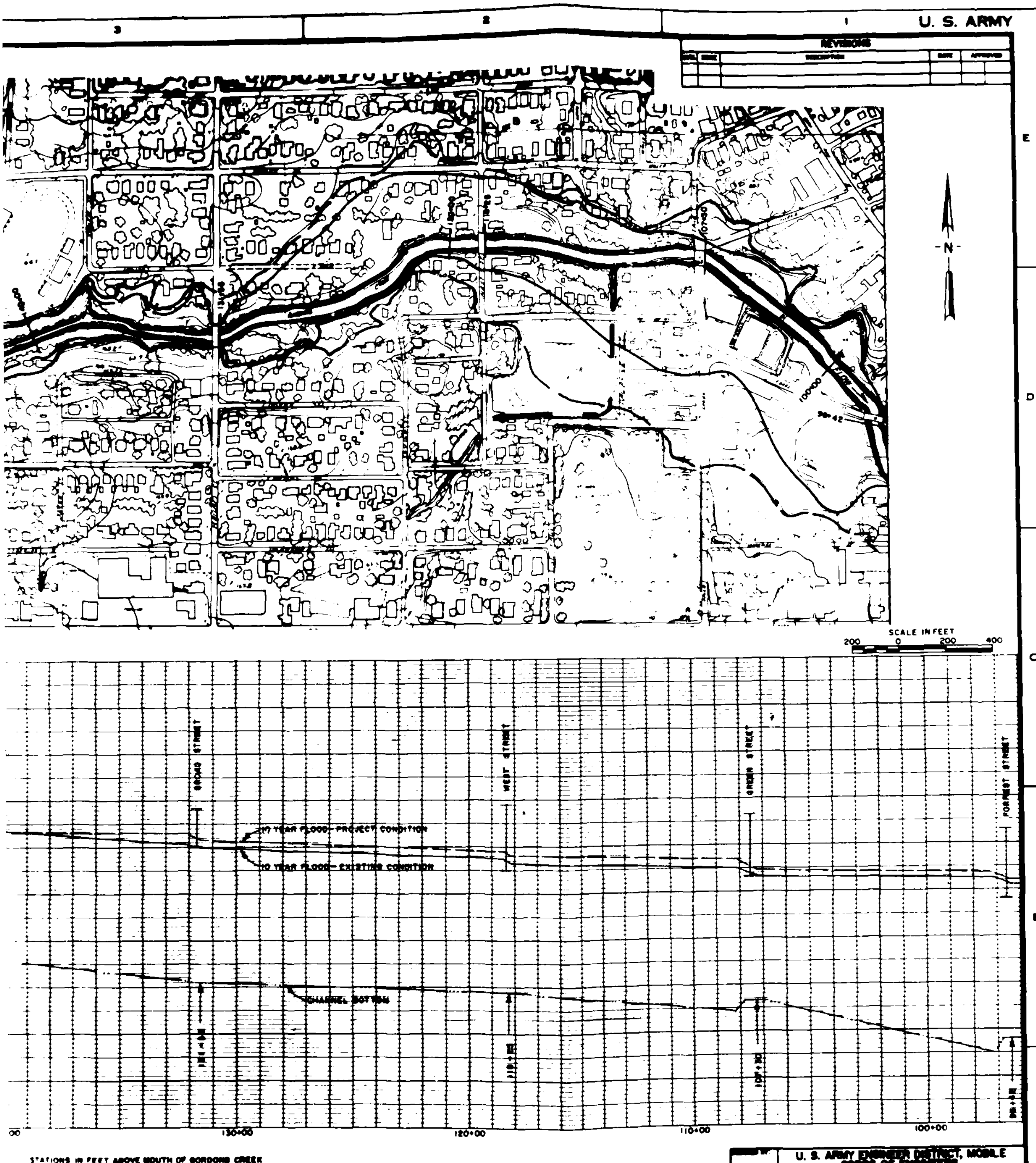
4

3



U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

UPPER GORDONS CREEK FLOOD CONTROL STUDY

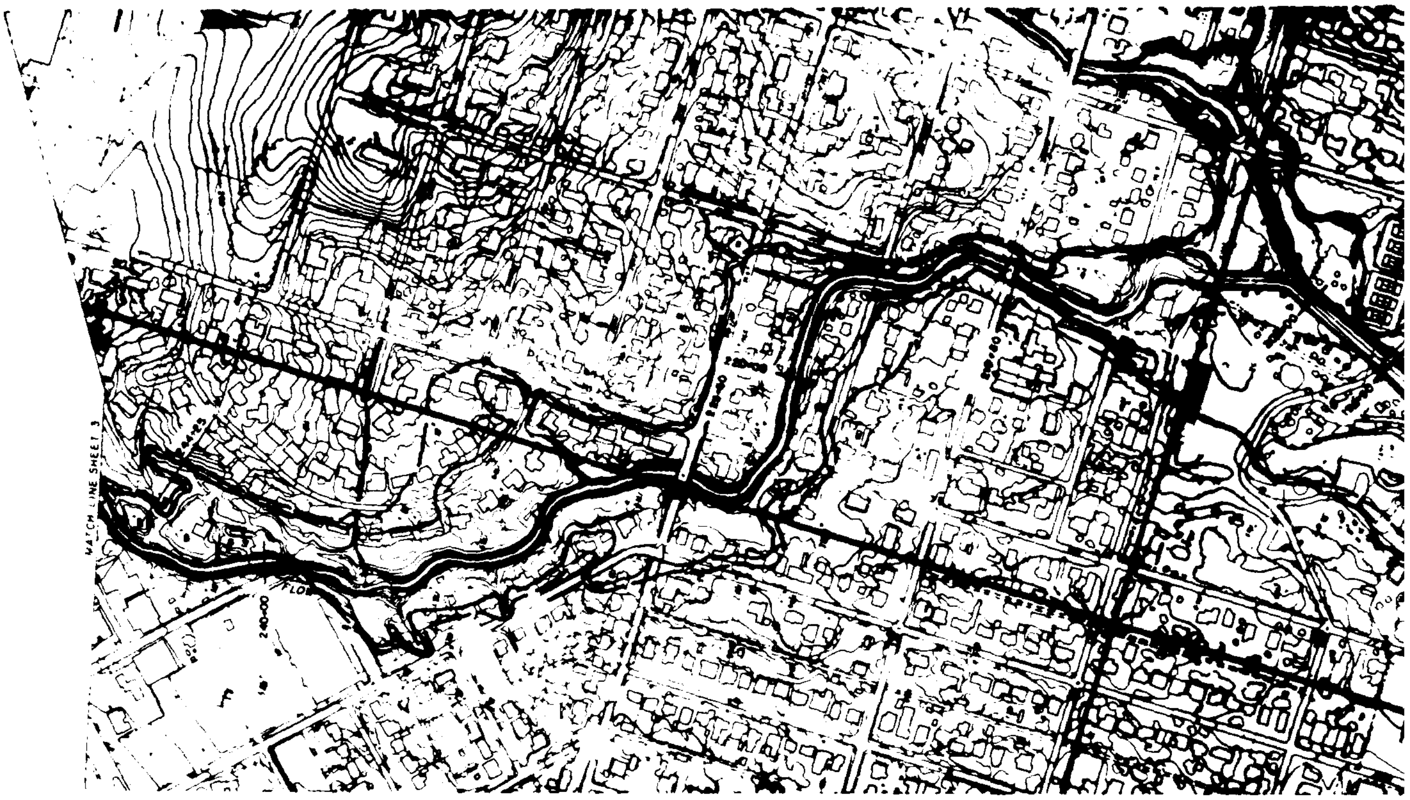
HATTIESBURG, MISSISSIPPI

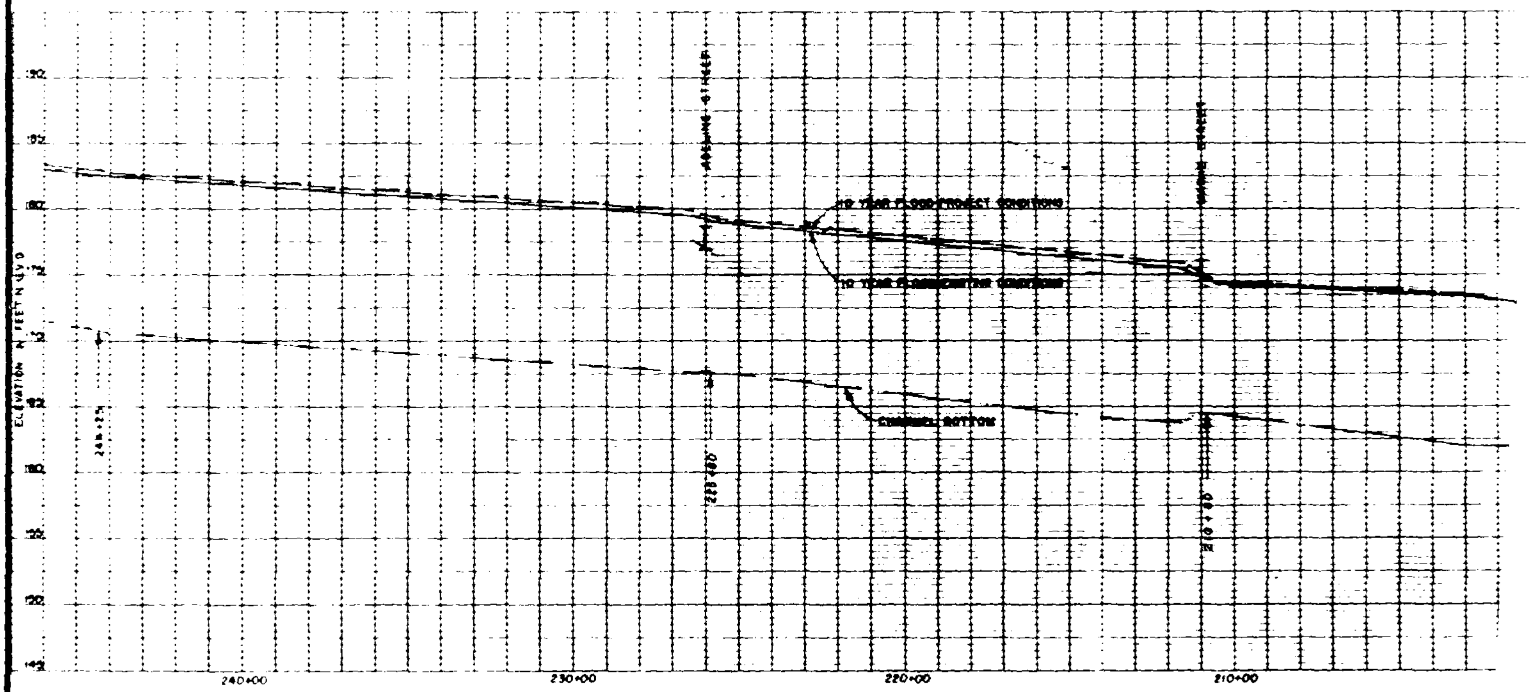
10-YEAR FLOOD PROFILE
WITH AND WITHOUT PROJECT

SHEET 1 OF 3

APPENDIX 2, CHART NO. 2-C-19

CORPS OF ENGINEERS | 4 | 3

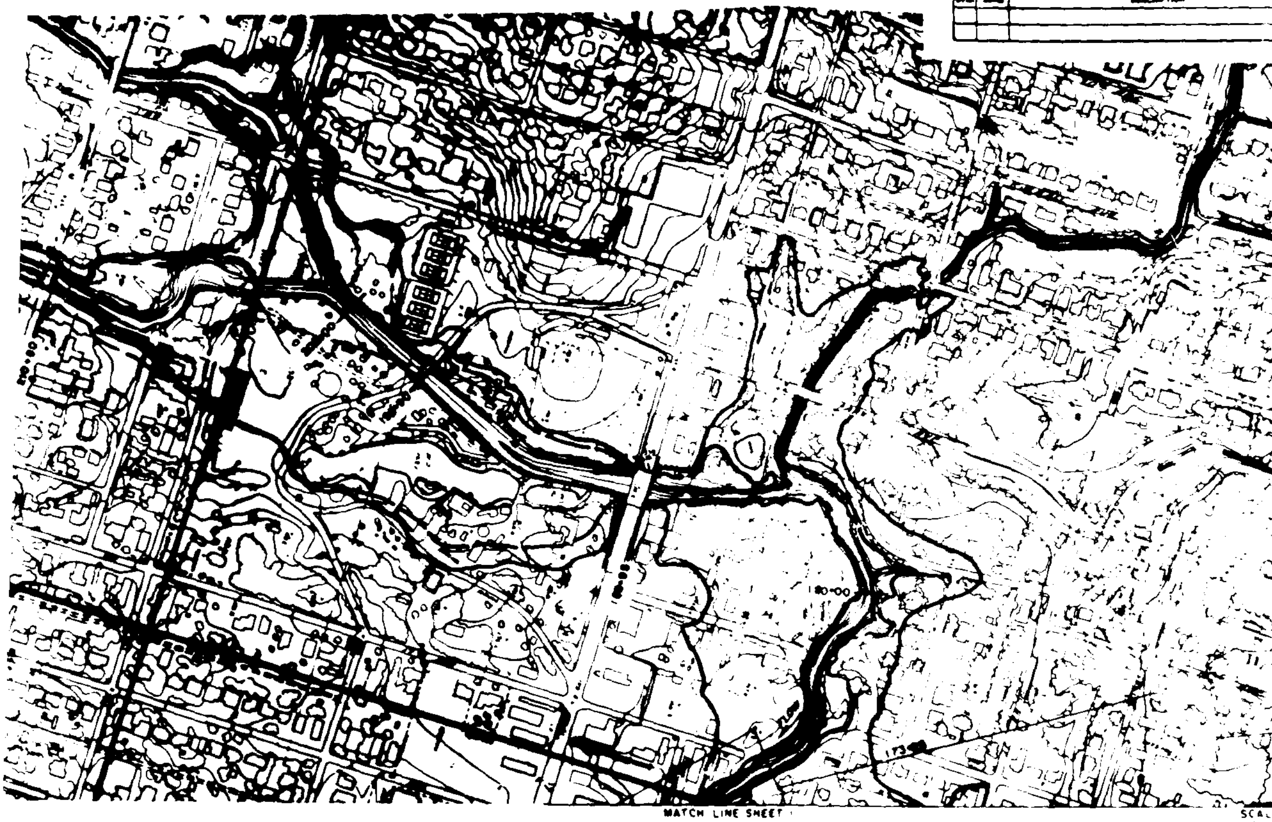


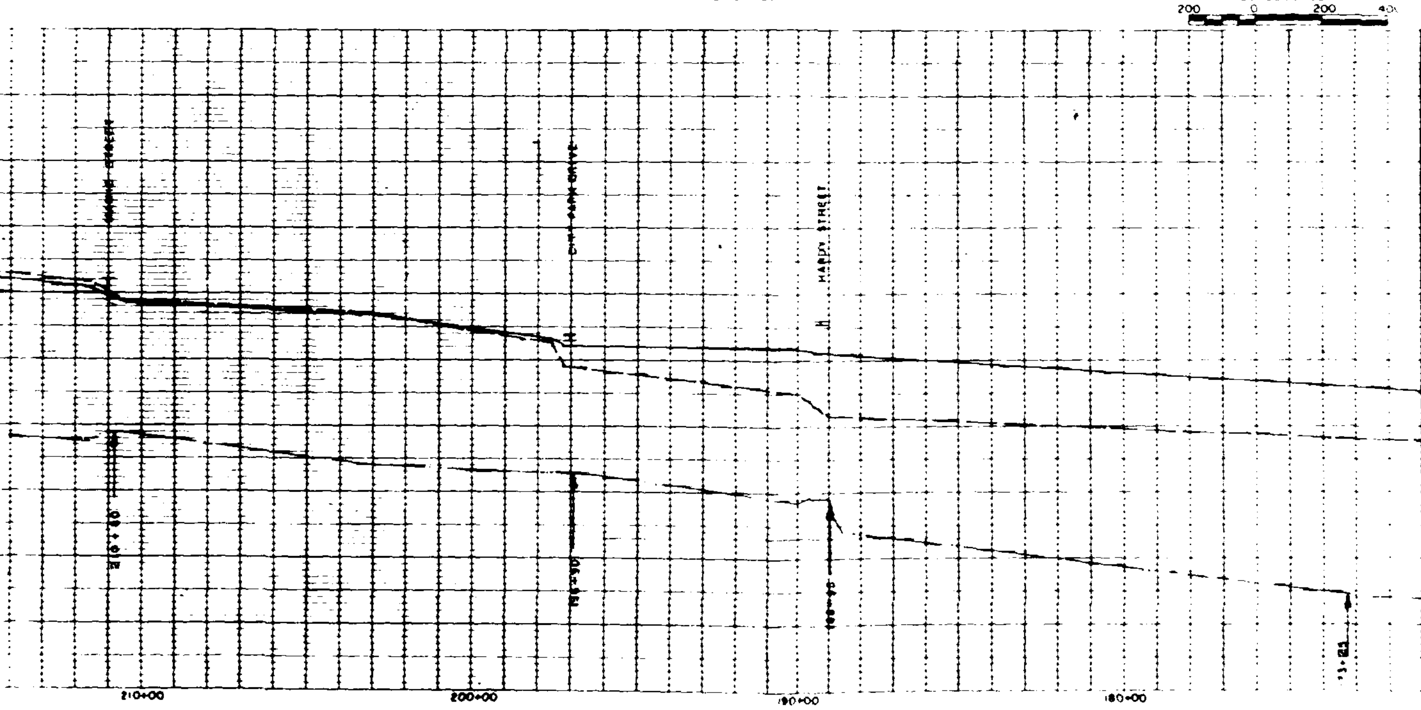


5 | 4 | 3

U. S. ARMY

REVISIONS





STATIONS IN FEET ABOVE MOUTH OF GORDONS CREEK

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

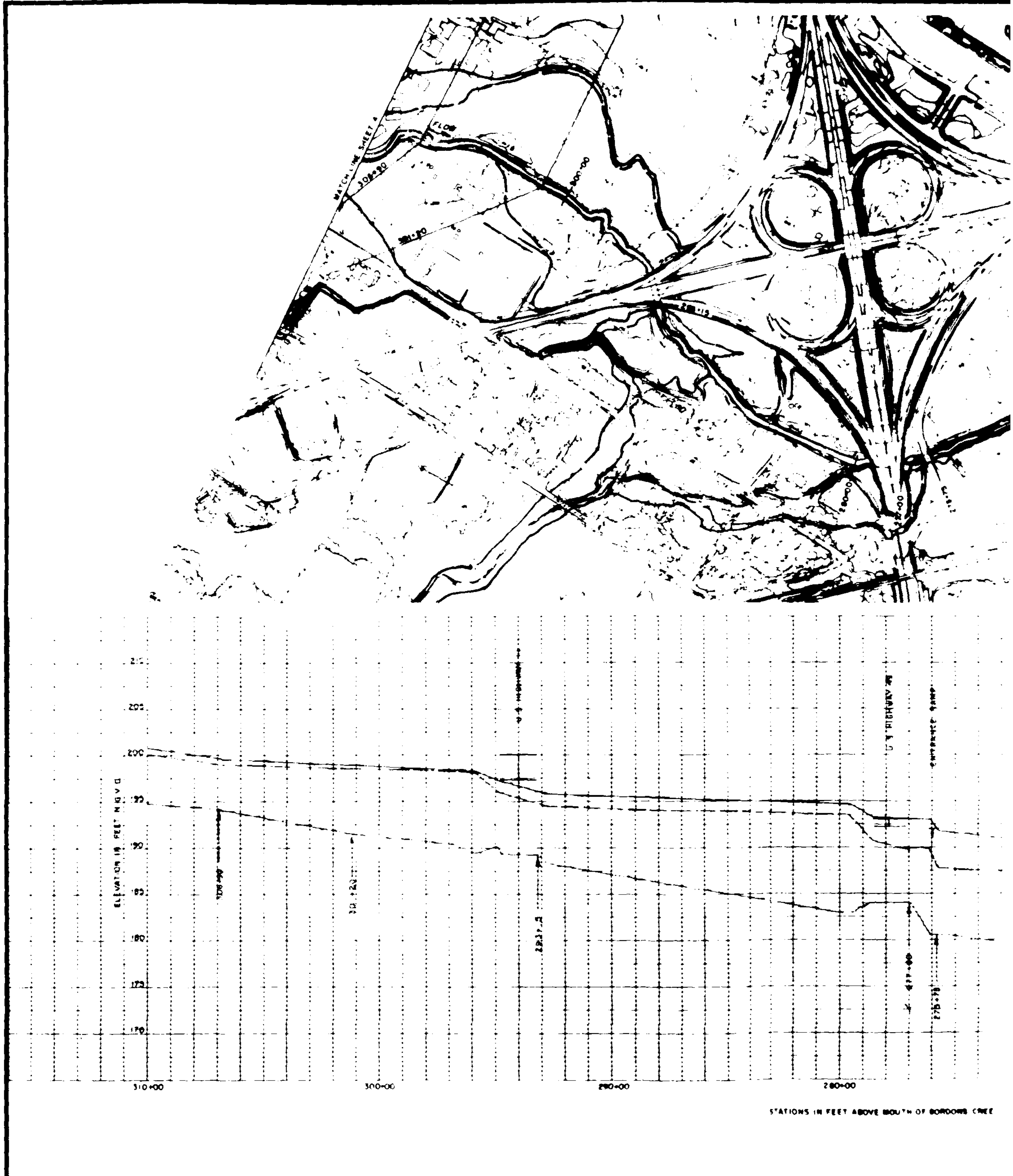
HATTIESBURG, MISSISSIPPI

10-YEAR FLOOD PROFILE
WITH AND WITHOUT PROJECT

CORPS OF ENGINEERS

4

3



5

4

3

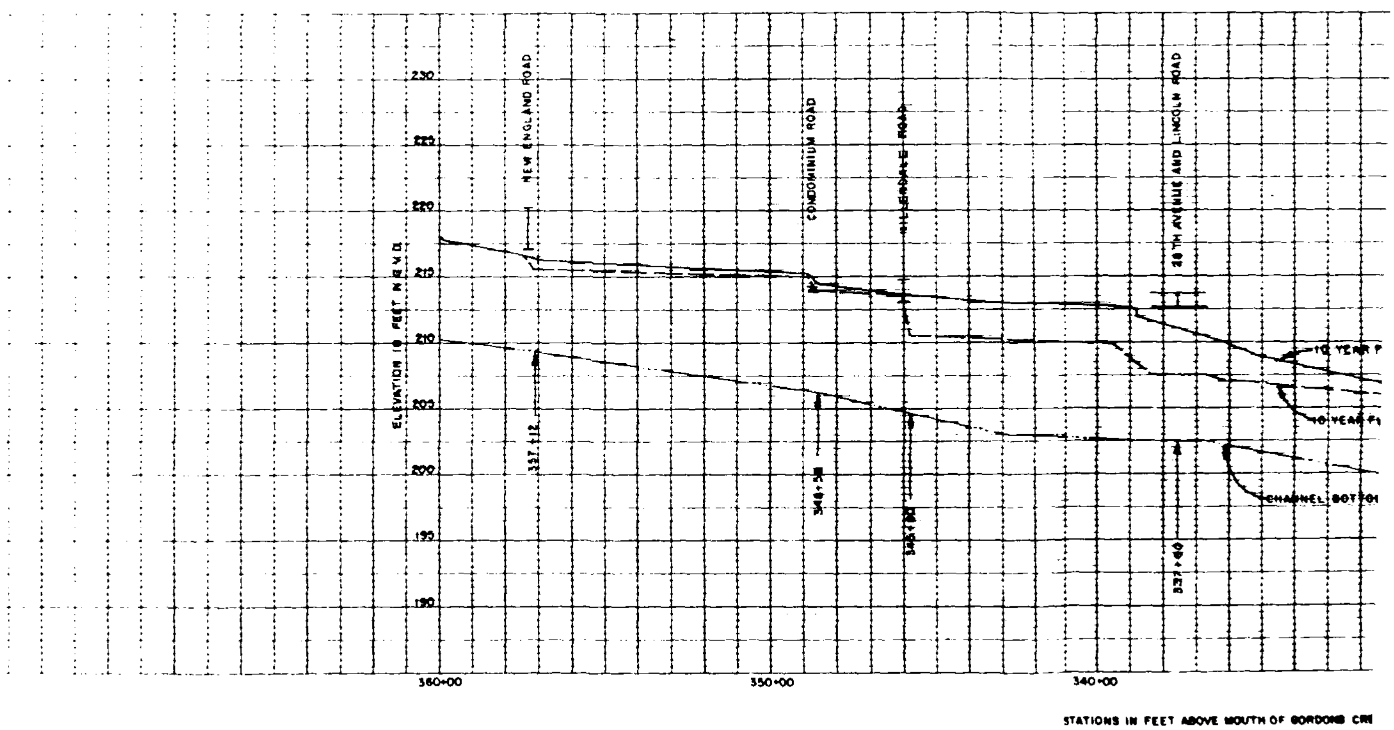
U. S. ARMY

STATIONS IN FEET ABOVE MOUTH OF GORDONS CREEK

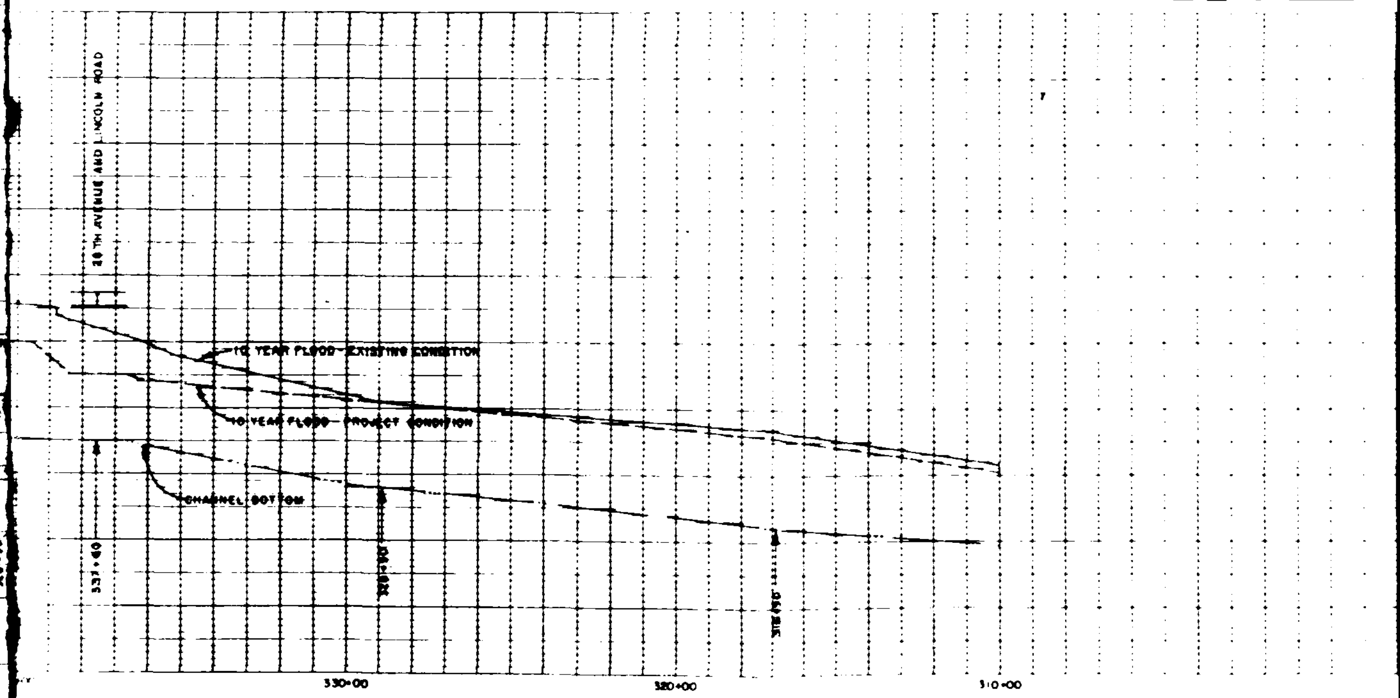
U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA

UPPER GORDONS CREEK FLOOD ... STUDY
HATTIESBURG, MISSISSIPPI
10-YEAR FLOOD PROFILE
WITH AND WITHOUT PROJECT


MATCH LINE SHEET 5
360+00
357+12
348+58
346+00
337+40


ELEVATION IN FEET N.G.V.D.
230
225
220
215
210
205
200
195
190
NEW ENGLAND ROAD
CONDOMINIUM ROAD
28TH AVENUE AND LINCOLN ROAD
357+12
348+58
337+40
360+00
350+00
340+00

REVISIONS



IN FEET ABOVE MOUTH OF GORDONS CREEK

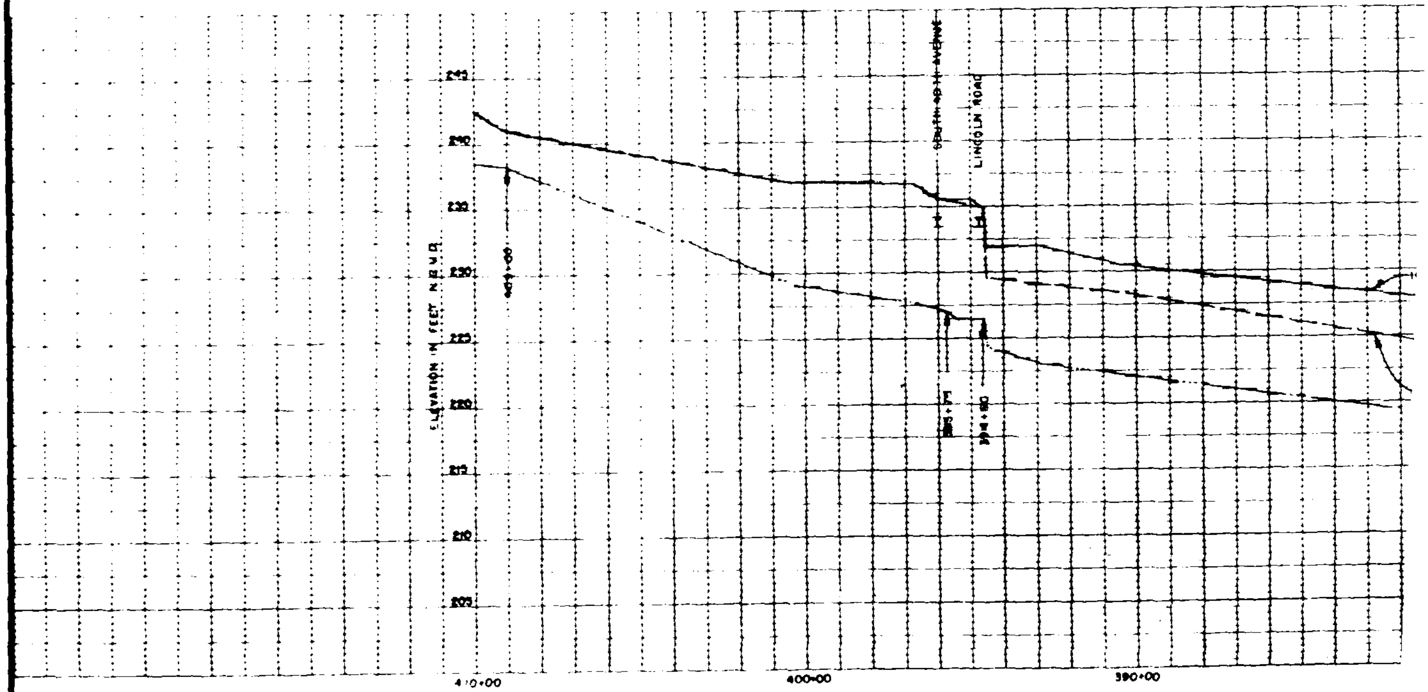
U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

UPPER GORDONS CREEK FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI

10-YEAR FLOOD PROFILE
WITH AND WITHOUT PROJECT

CORPS OF ENGINEERS

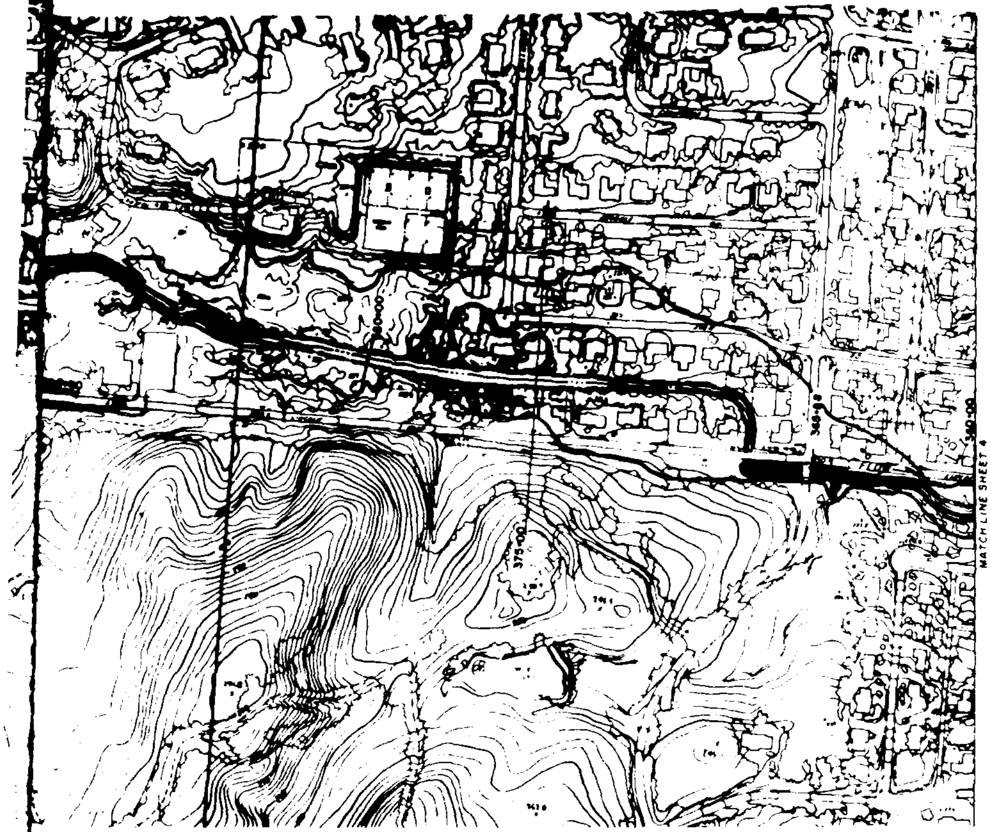
4 3

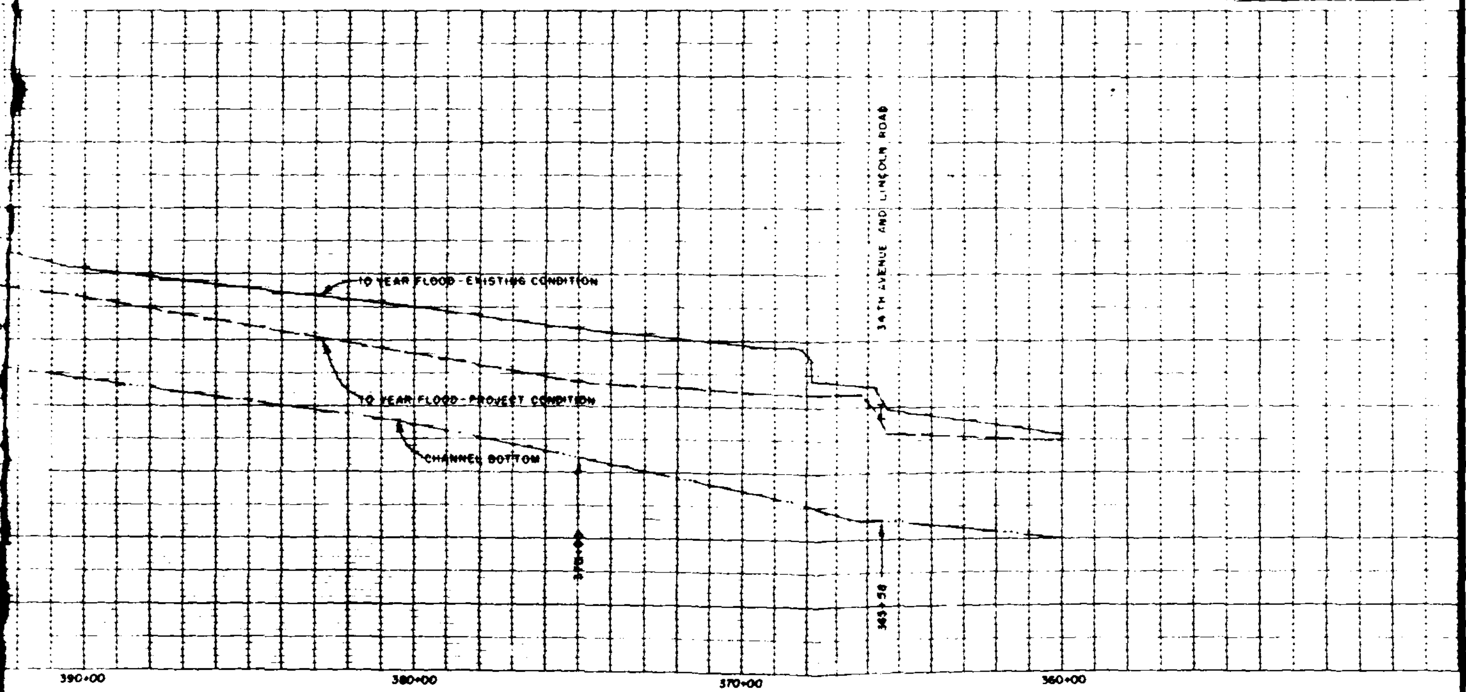


5 4 3

U. S. ARMY

REVISIONS				
SYM.	ZONE	DESCRIPTION	DATE	APPROVED





STATIONS IN FEET ABOVE MOUTH OF GORDONS CREEK

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

UPPER GORDONS CREEK FLOOD CONTROL STUDY

HATTIESBURG, MISSISSIPPI

10-YEAR FLOOD PROFILE
WITH AND WITHOUT PROJECT

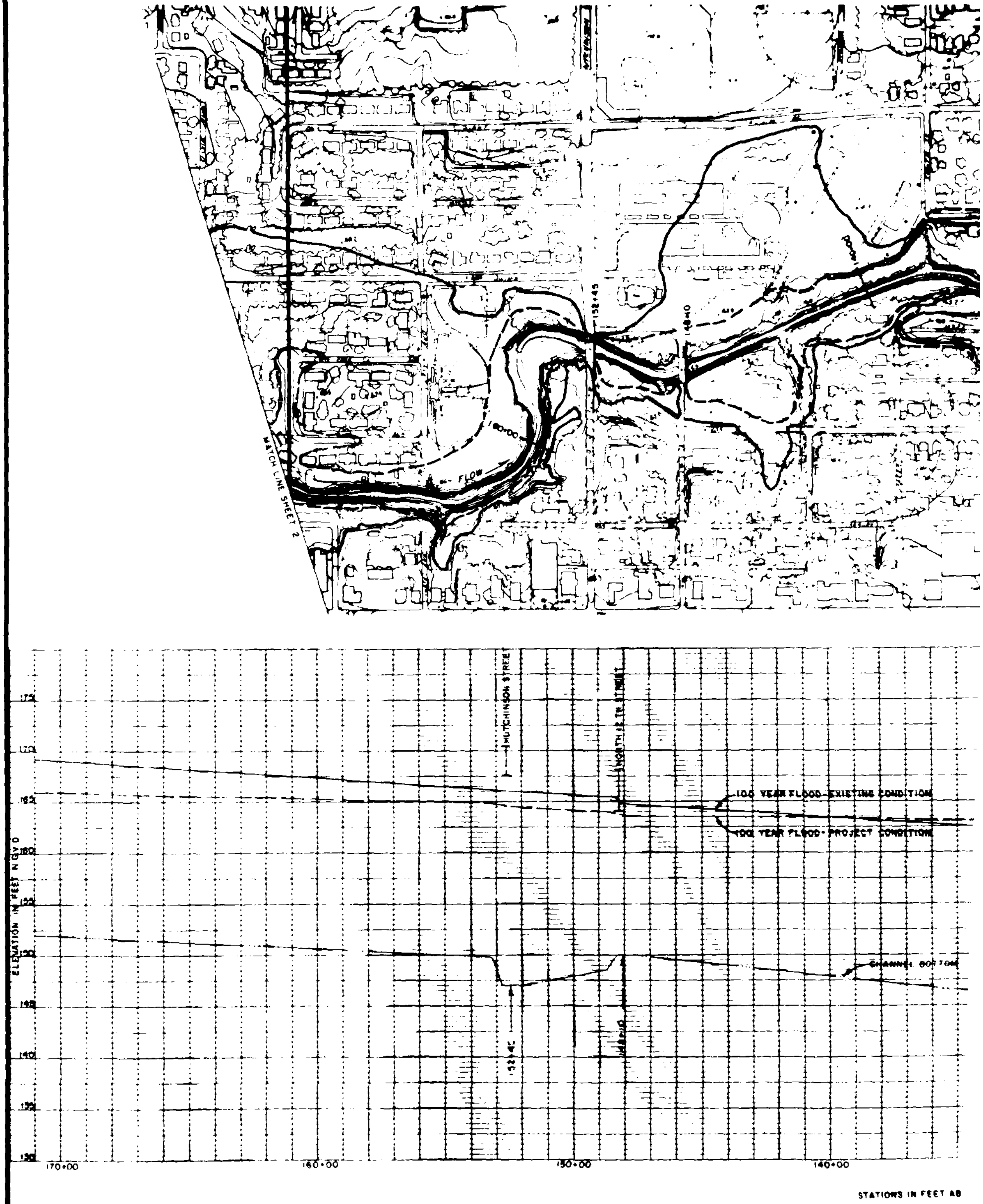
SHEET 5 OF 5

APPENDIX 2, CHART NO. 2-C-23

CORPS OF ENGINEERS

4

3



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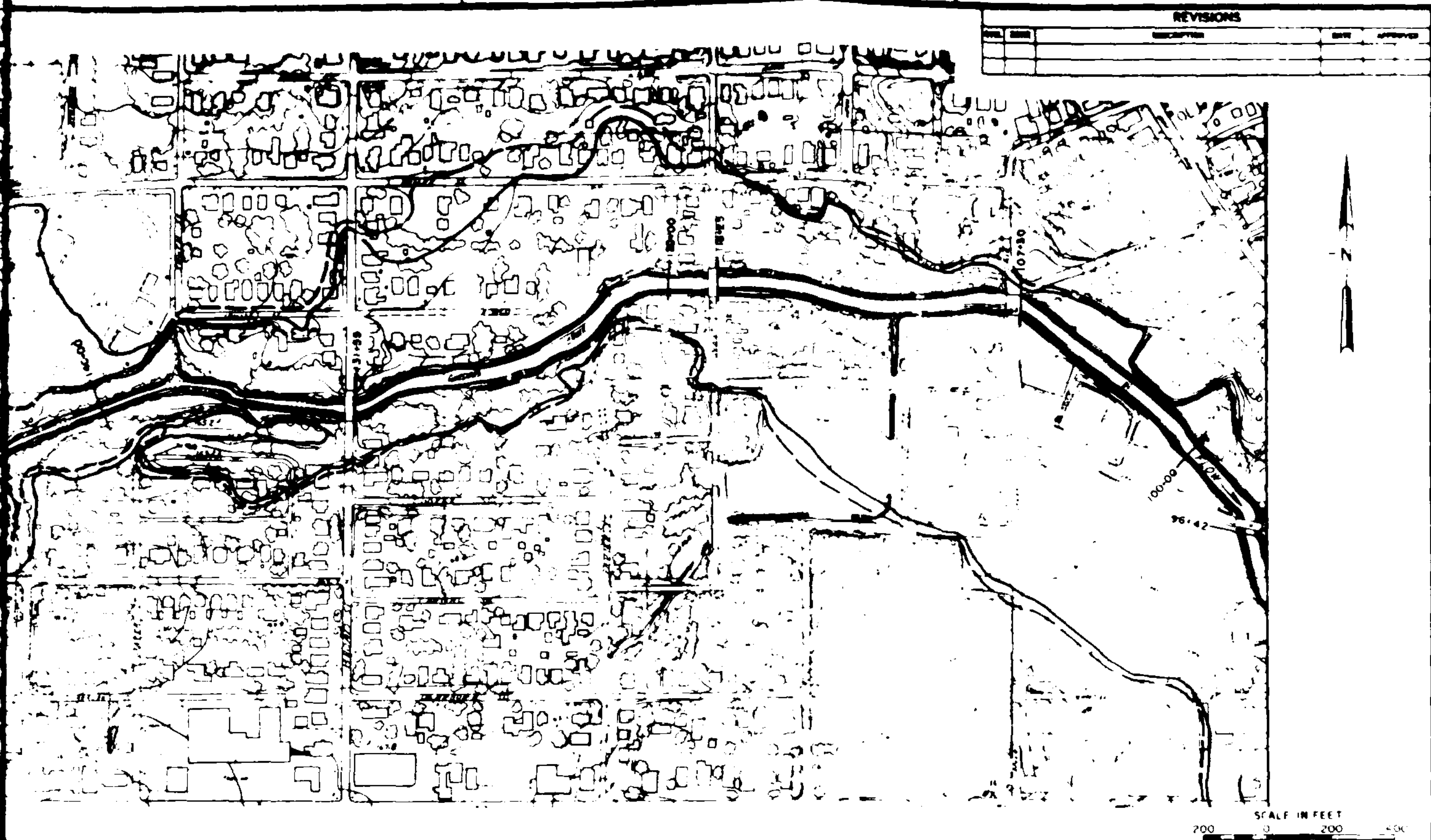
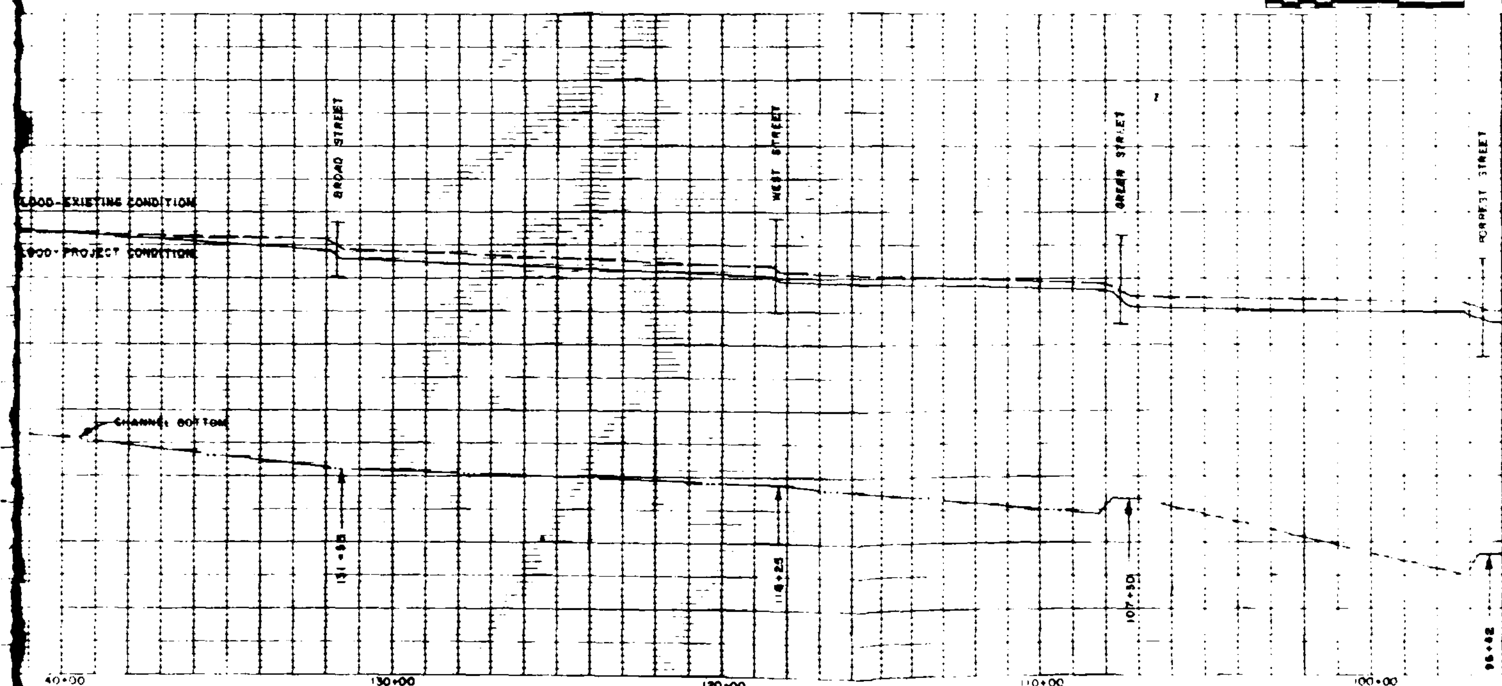
4

U. S. ARMY





STATIONS IN FEET ABOVE MOUTH OF GORDONS CREEK

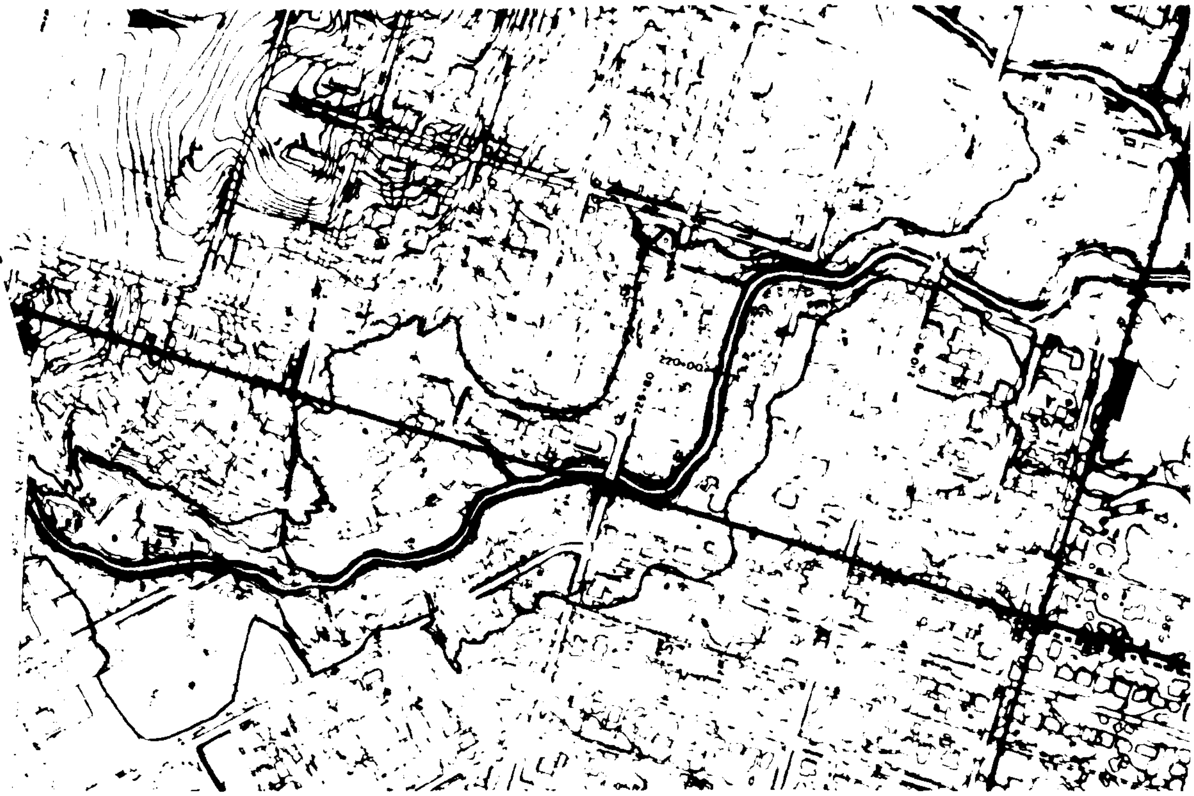
U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

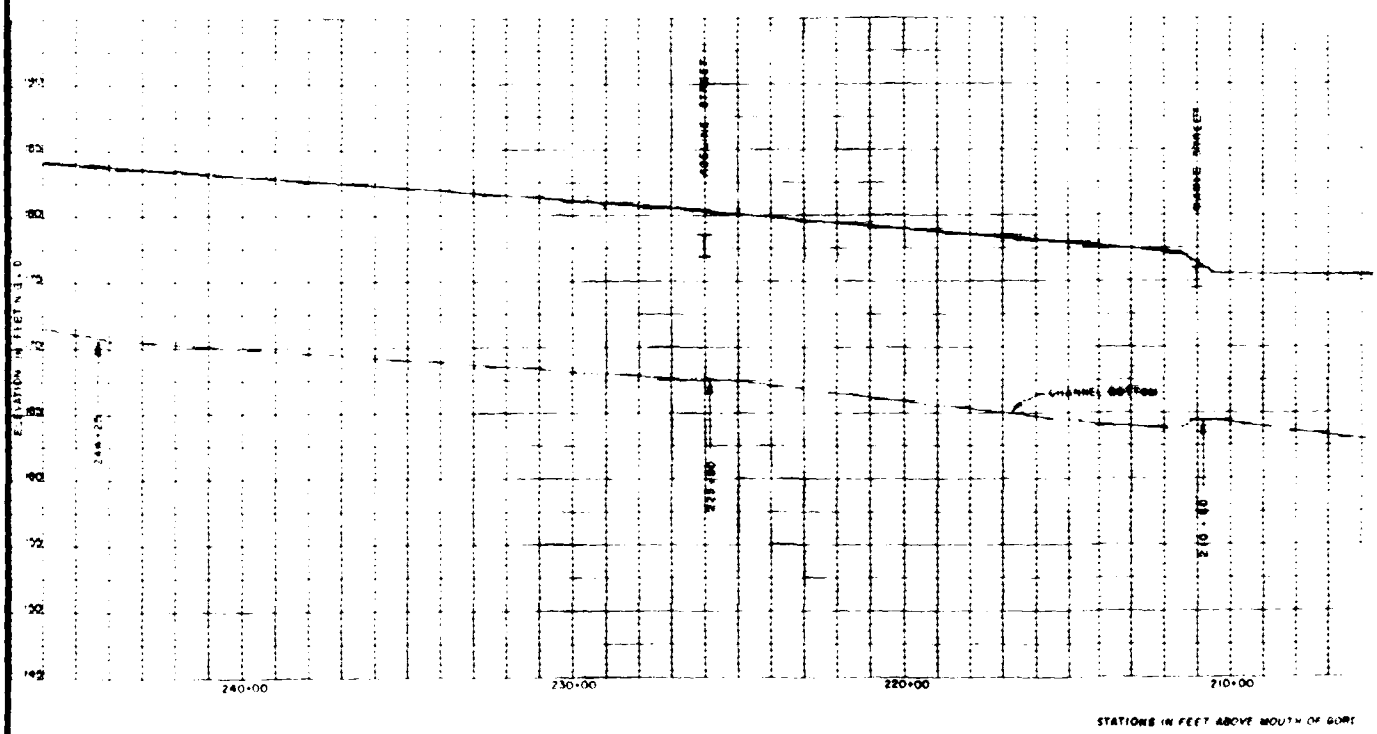
HATTIESBURG, MISSISSIPPI

100-YEAR FLOOD PROFILE
WITH AND WITHOUT PROJECT

CORPS OF ENGINEERS

4 3

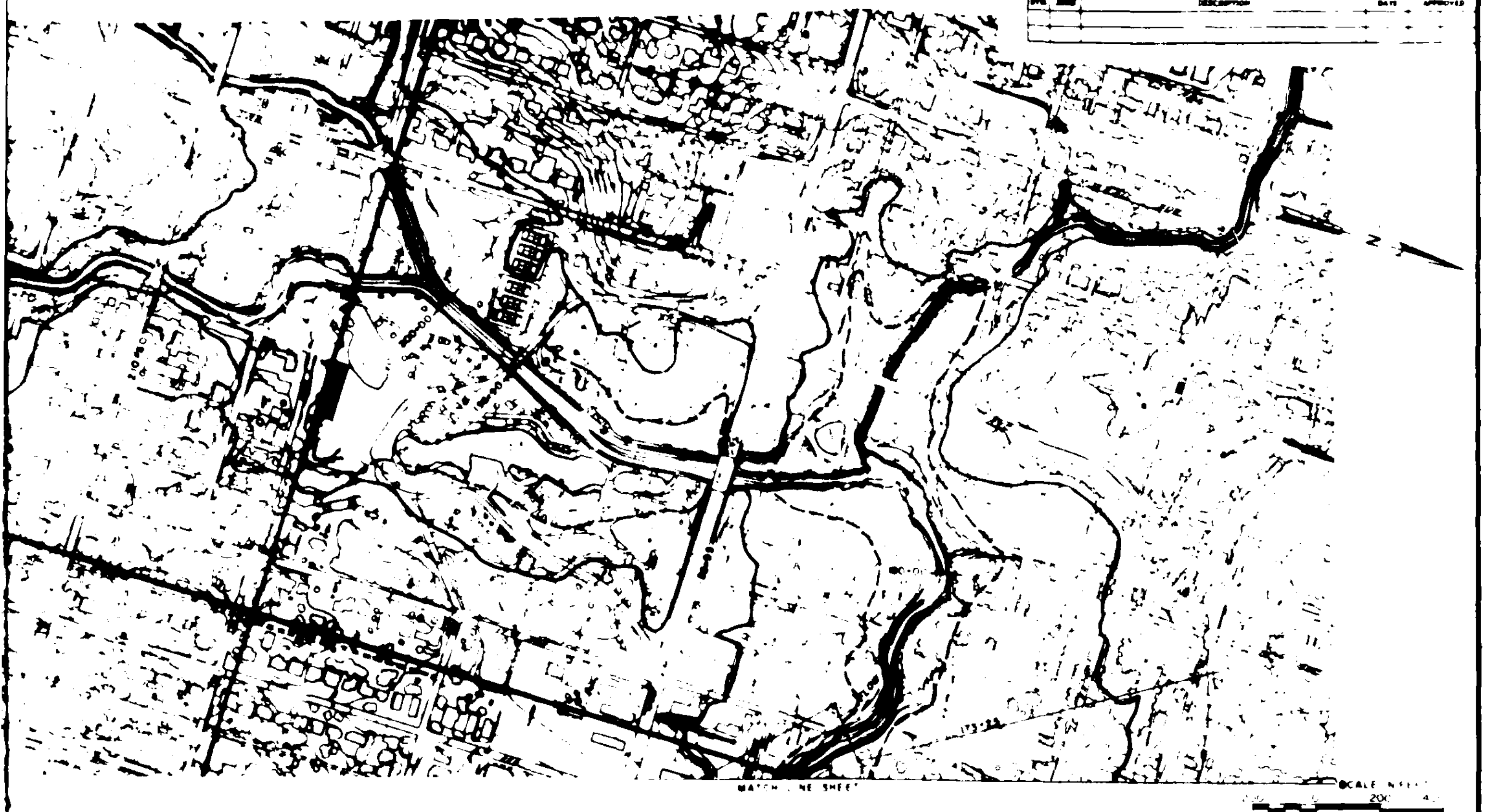




5 4 3

U. S. ARMY

REVISIONS



STATIONS IN FEET ABOVE MOUTH OF GORDONS CREEK

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA

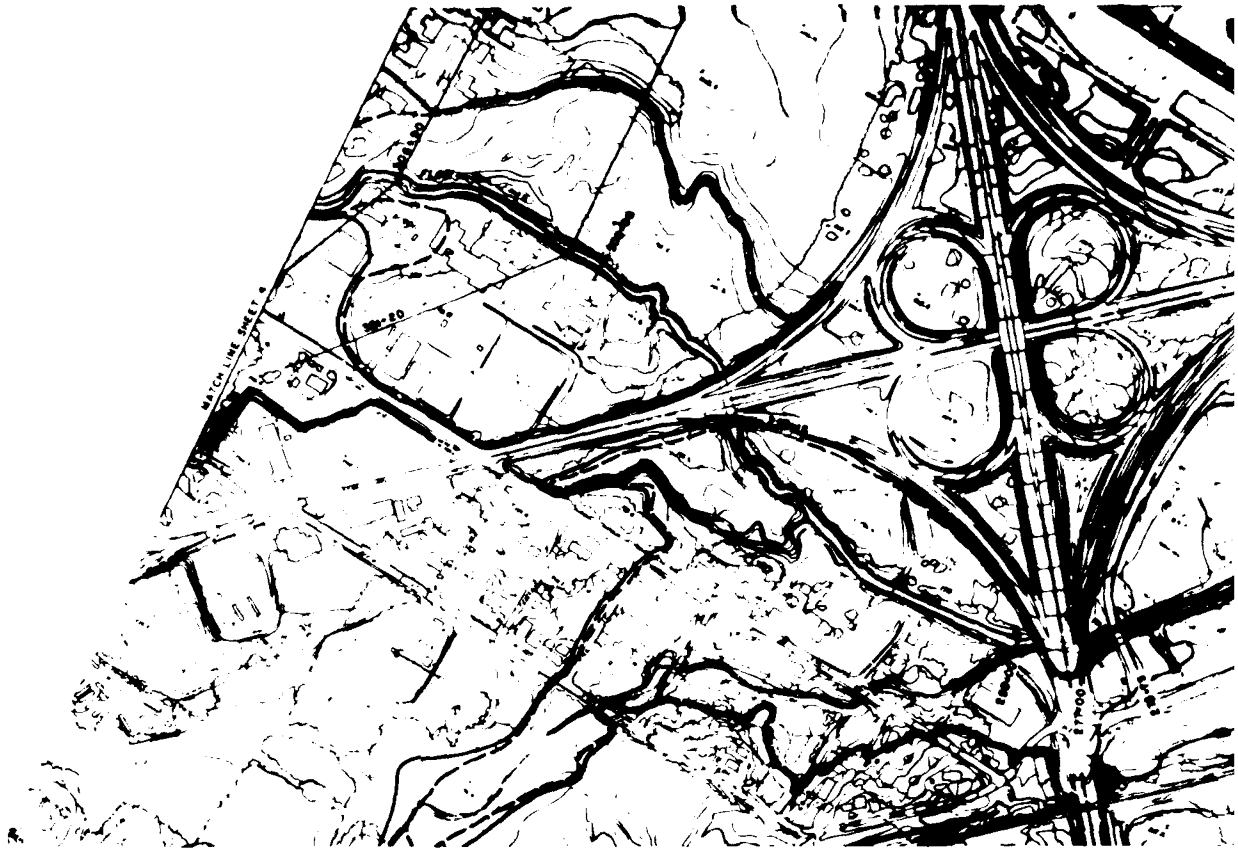
UPPER GORDONS CREEK FLOOD CONTROL STUDY

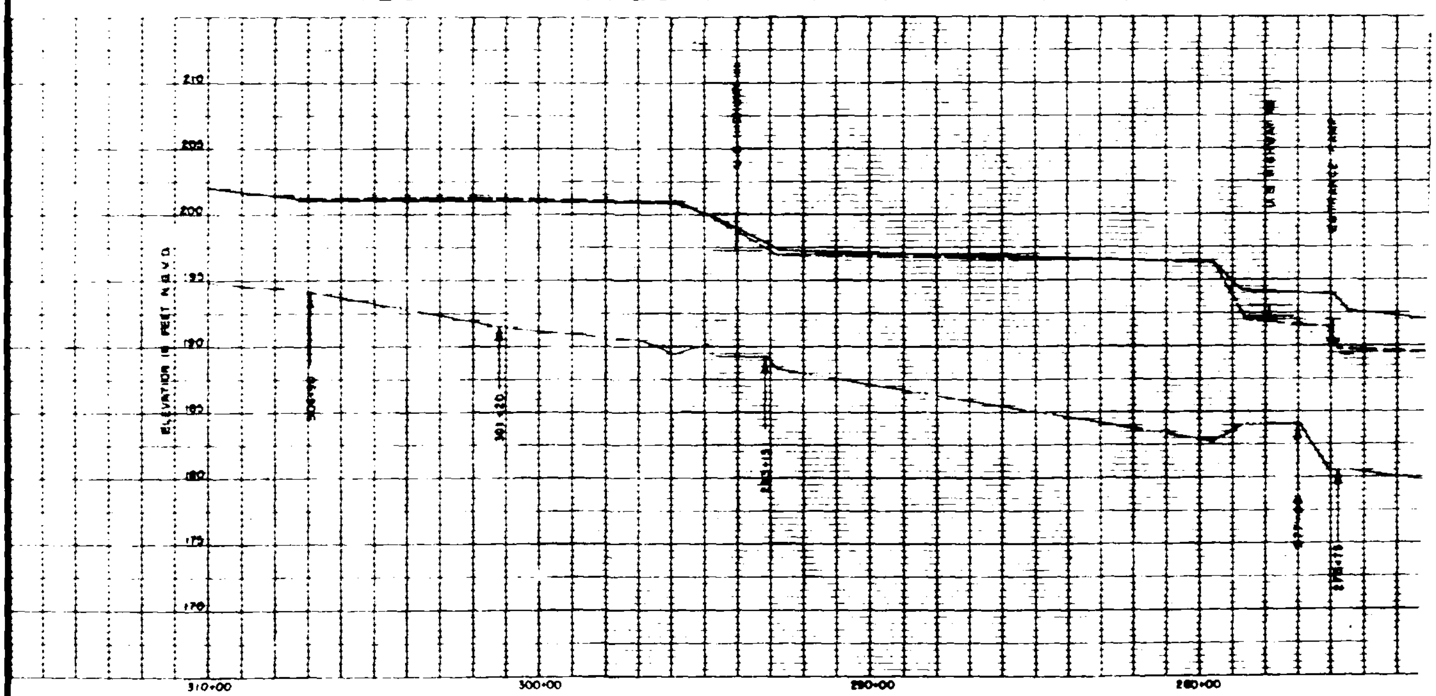
HATTIESBURG, MISSISSIPPI

100-YEAR FLOOD PROFILE
WITH AND WITHOUT PROJECT

SHEET 2 OF 3

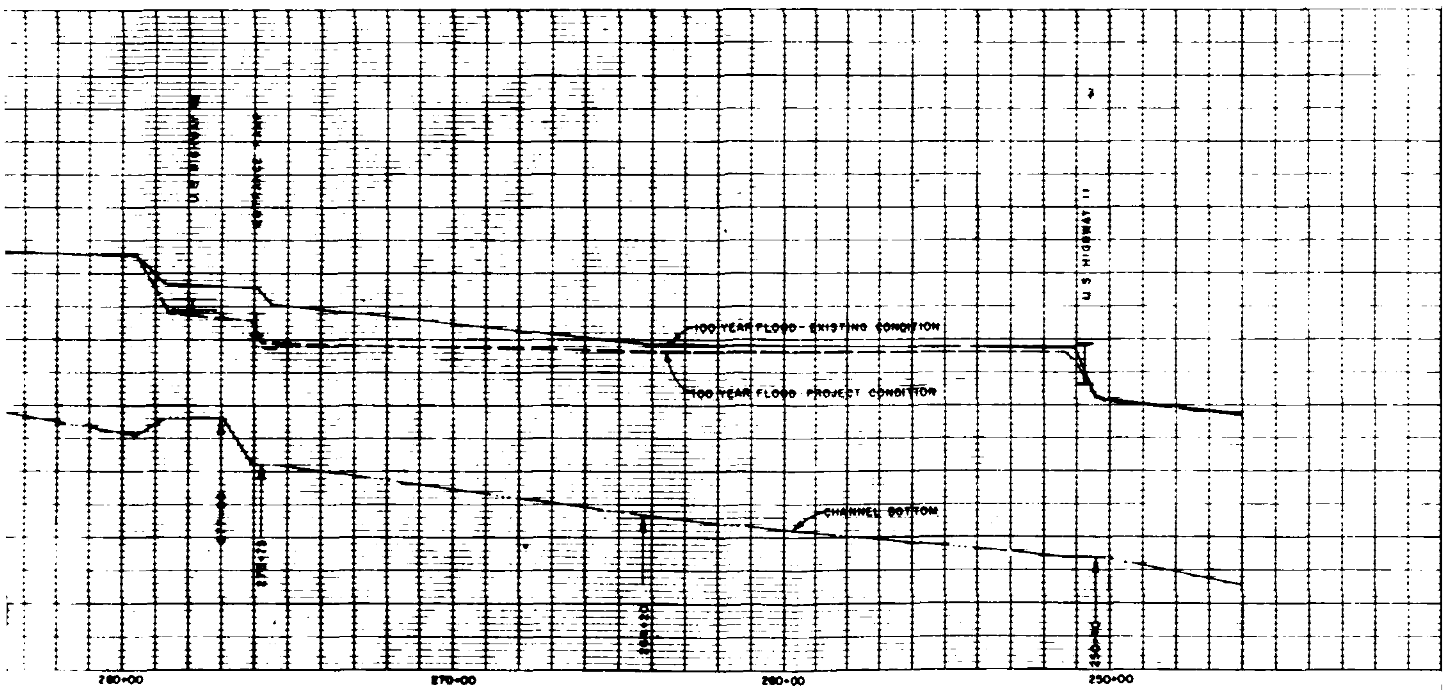
CORPS OF ENGINEERS | 4 | 3





STATIONS IN FEET ABOVE MOUTH OF GORDONS

5 | 4 | 3



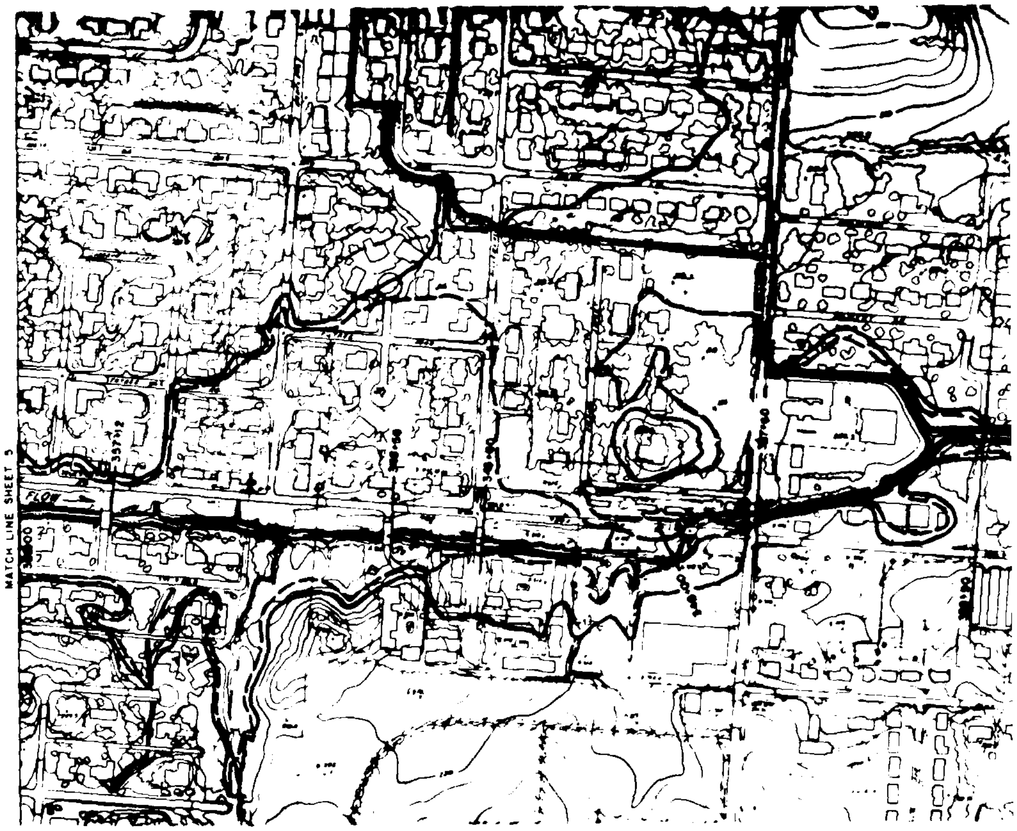
STATIONS IN FEET ABOVE MOUTH OF GORDONS CREEK

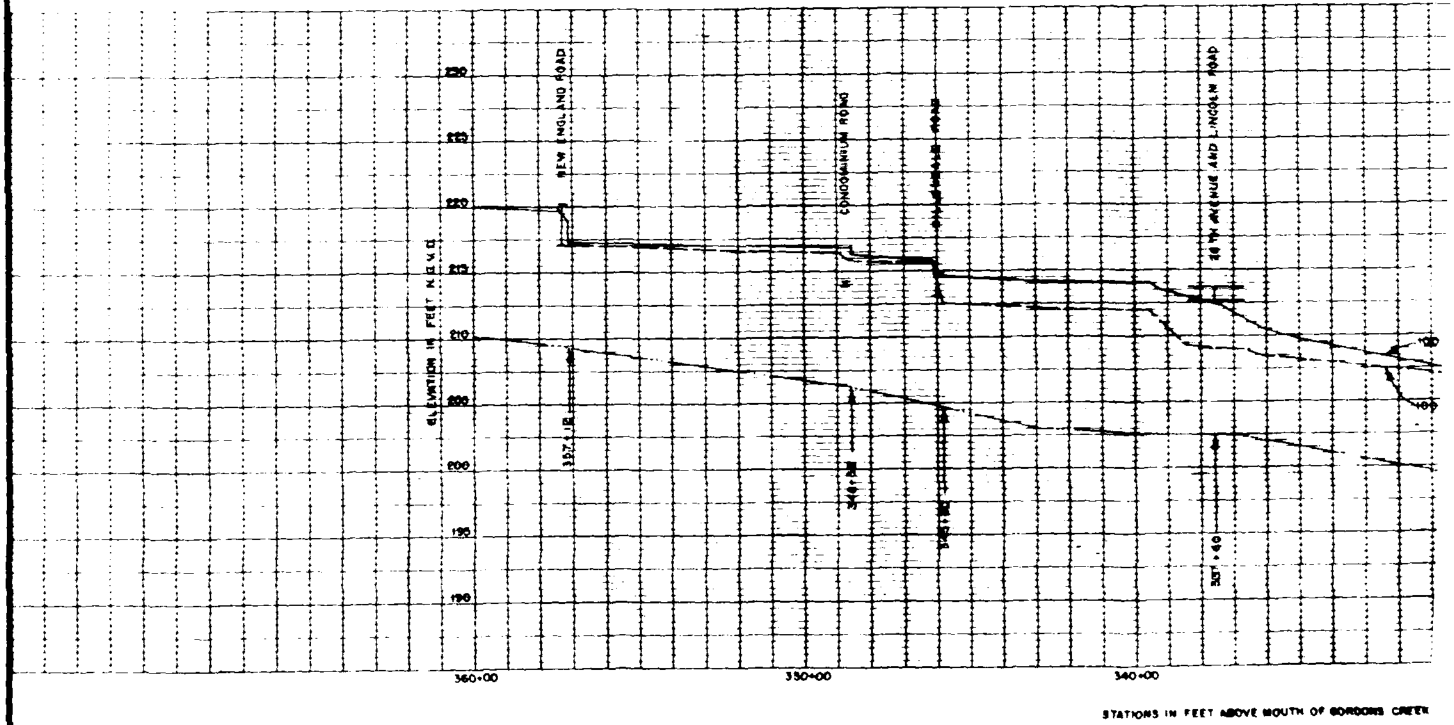
	U. S. ARMY ENGINEER DISTRICT, MOBILE CORPS OF ENGINEERS MOBILE, ALA.
	UPPER GORDONS CREEK FLOOD CONTROL STUDY HATTIESBURG, MISSISSIPPI
	100-YEAR FLOOD PROFILE WITH AND WITHOUT PROJECT
	SHEET 3 OF 5

CORPS OF ENGINEERS

4

3



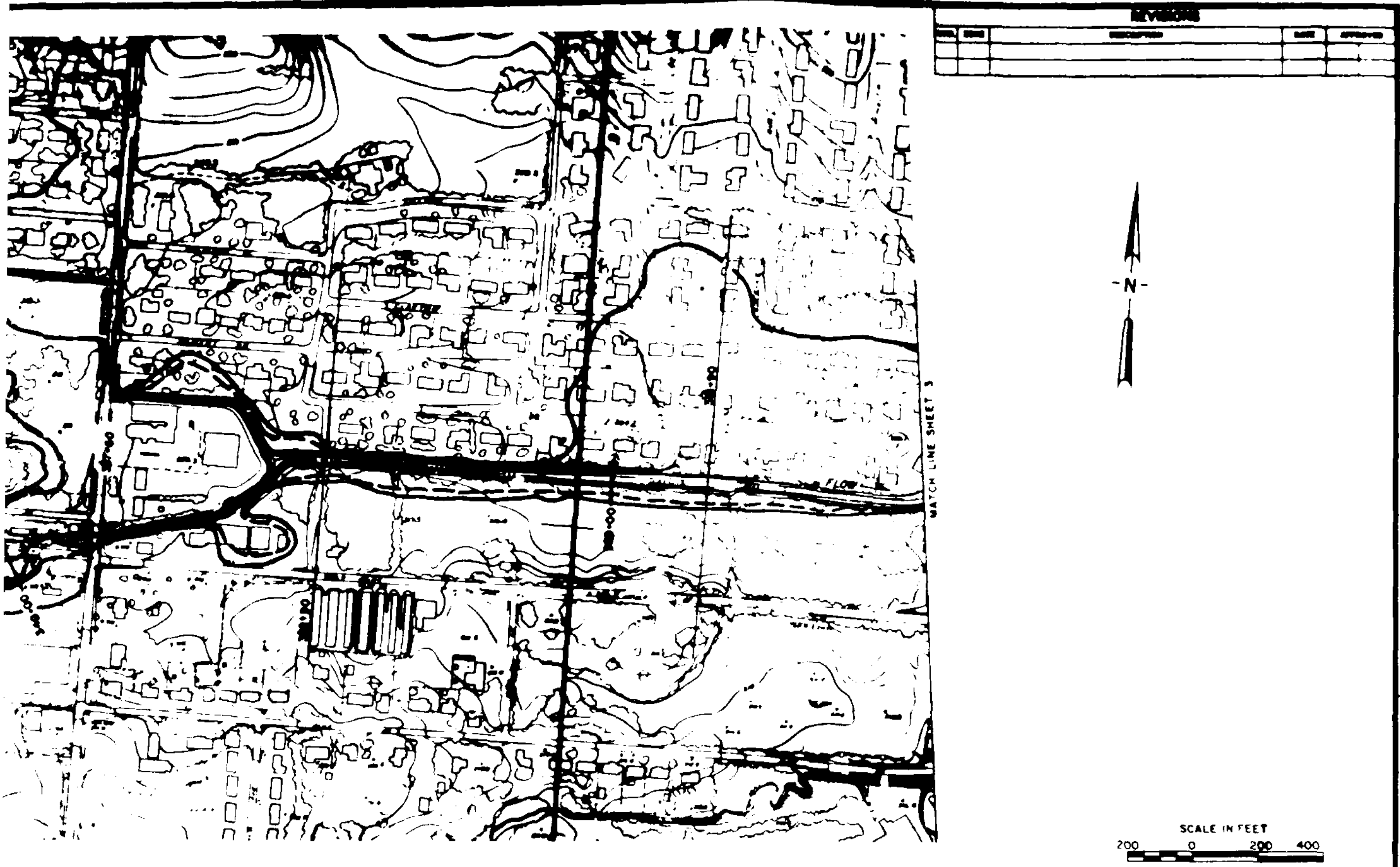


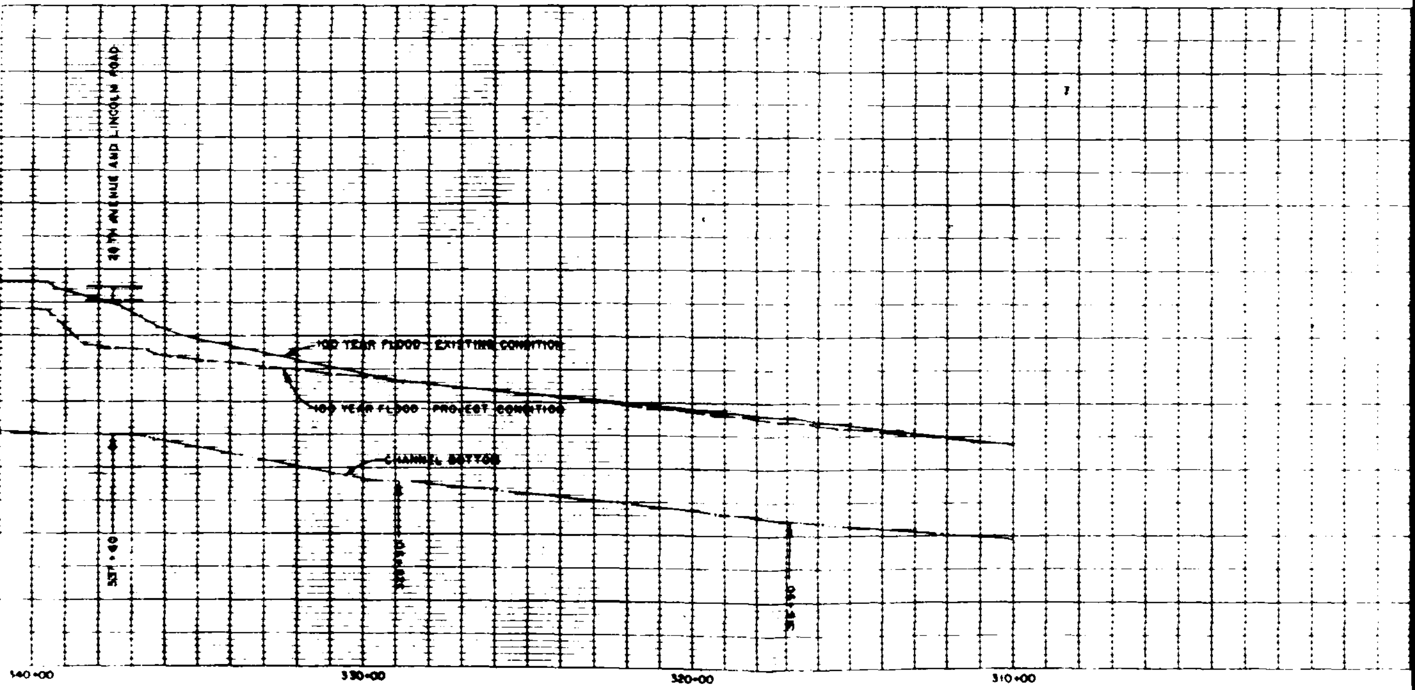
5

4

3

U. S. ARMY





STATIONS IN FEET ABOVE MOUTH OF GORDONS CREEK

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

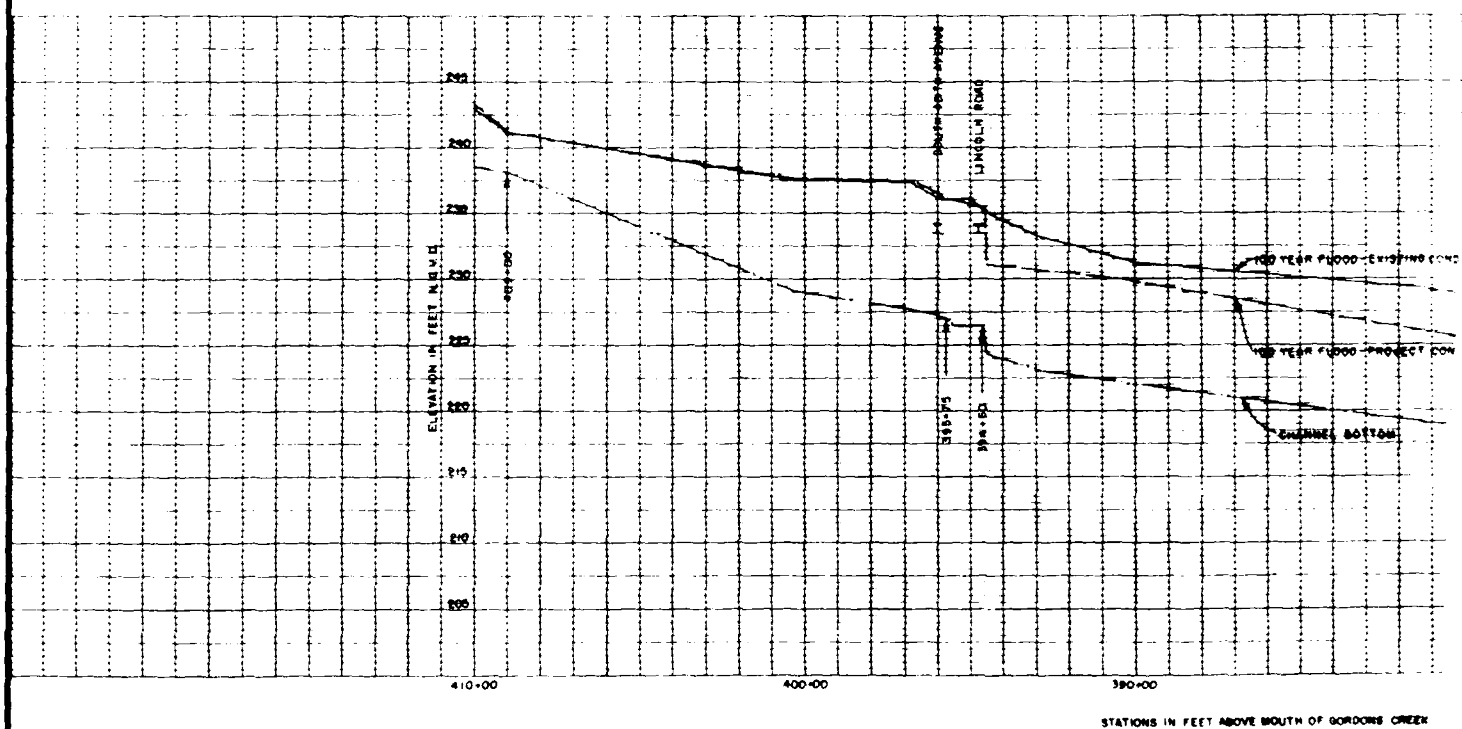
UPPER GORDONS CREEK FLOOD CONTROL STUDY

HATTIESBURG, MISSISSIPPI

100-YEAR FLOOD PROFILE
WITH AND WITHOUT PROJECT

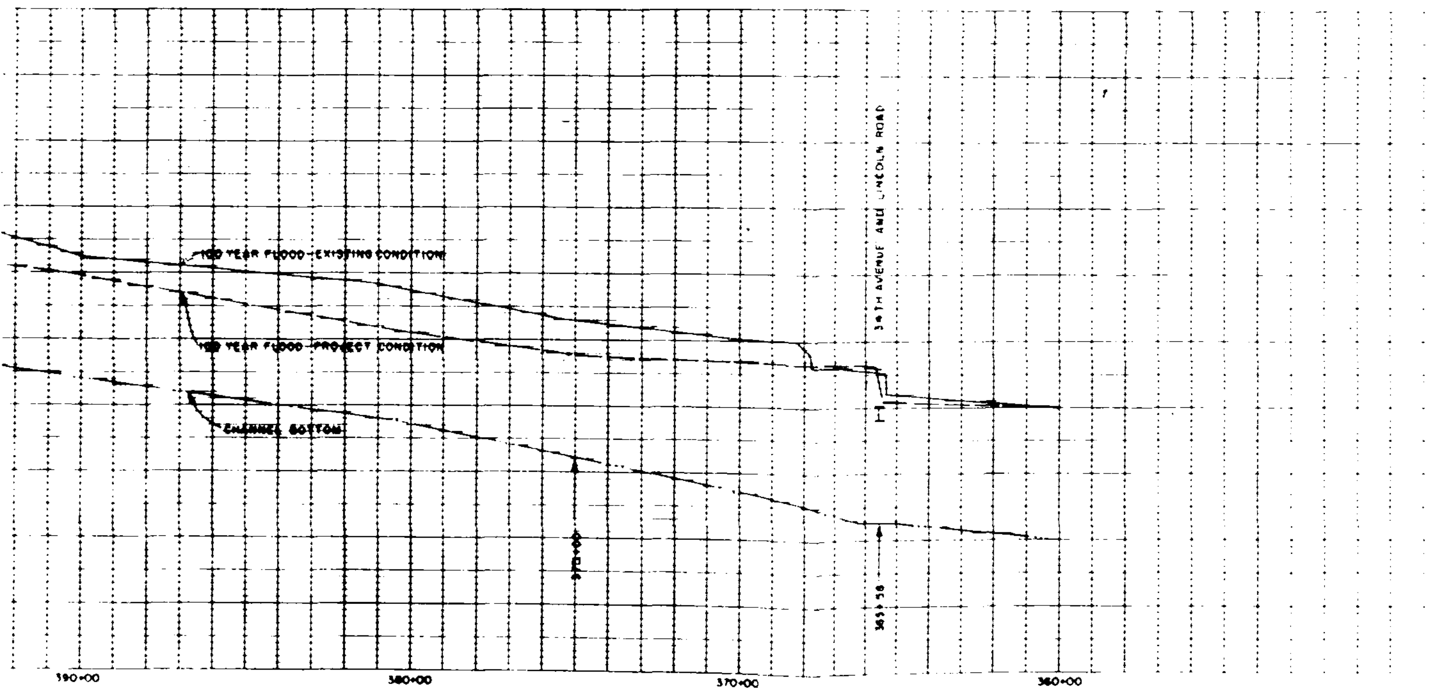
SHEET 4 OF 5

APPENDIX 2, CHART NO. 2-C-27


ELEVATION IN FEET N.G.V.D.
240
235
230
225
220
215
210
LINCOLN ROAD
404+50
395+75
394+50
100 YEAR FLOOD - EXISTING COND
100 YEAR FLOOD - PROJECT CON
CHANNEL BOTTOM
410+00
400+00
390+00
STATIONS IN FEET ABOVE MOUTH OF GORDONS CREEK

U. S. ARMY

REVISIONS



STATIONS IN FEET ABOVE MOUTH OF GORDONS CREEK

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

UPPER GORDONS CREEK FLOOD CONTROL STUDY

HATTIESBURG, MISSISSIPPI

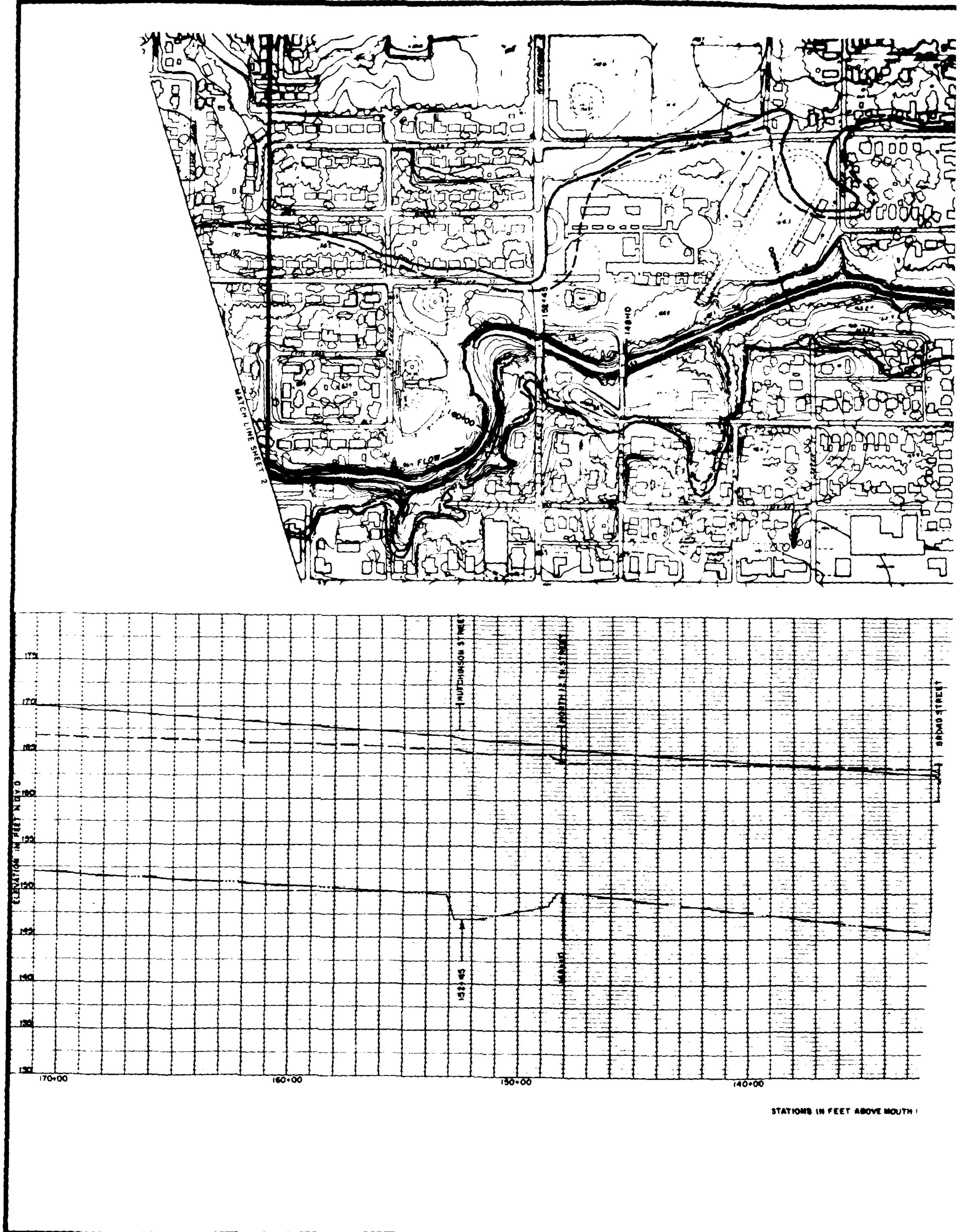
100-YEAR FLOOD PROFILE
WITH AND WITHOUT PROJECT

SHEET 5 OF 5

CORPS OF ENGINEERS

4

3



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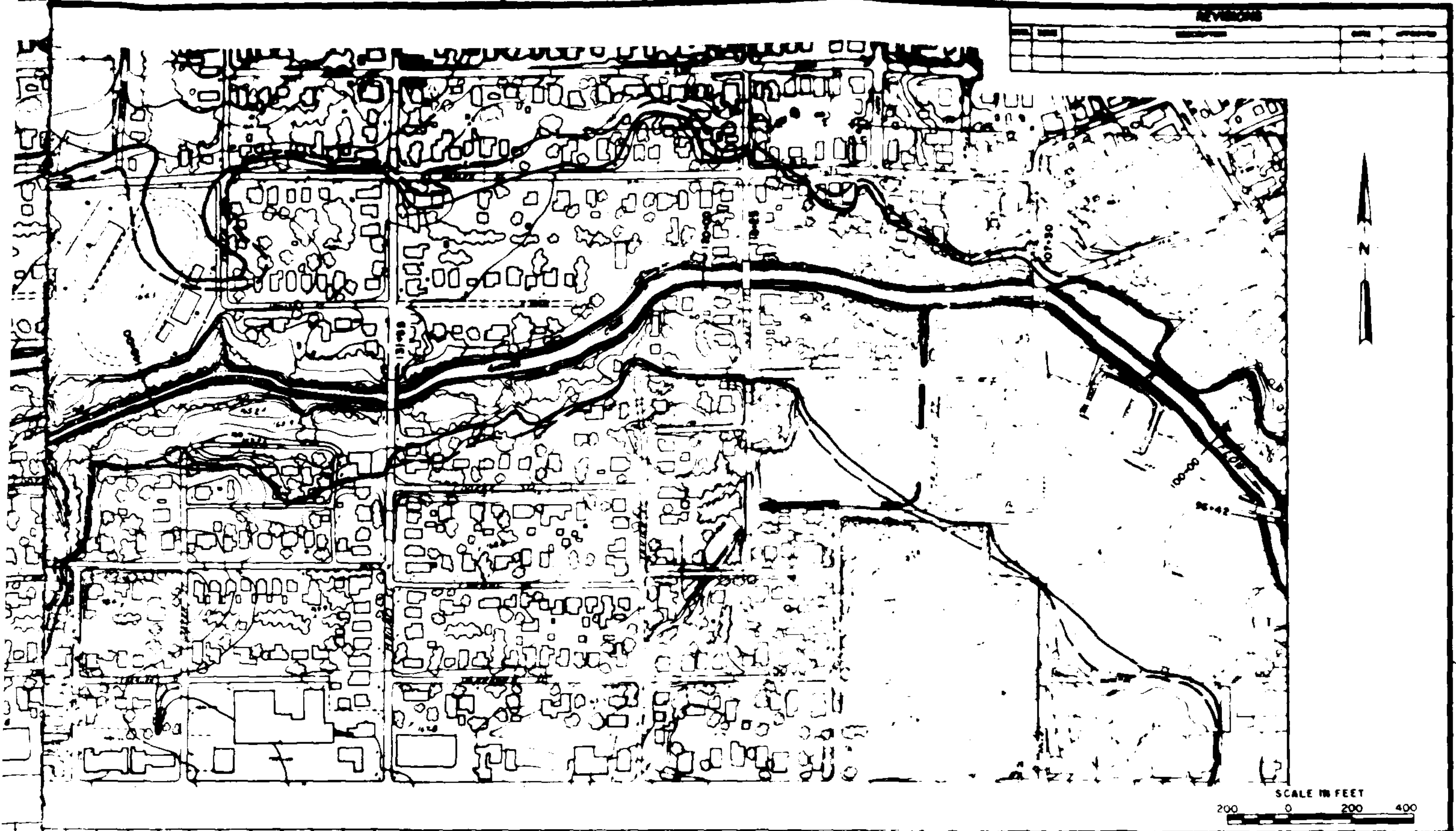
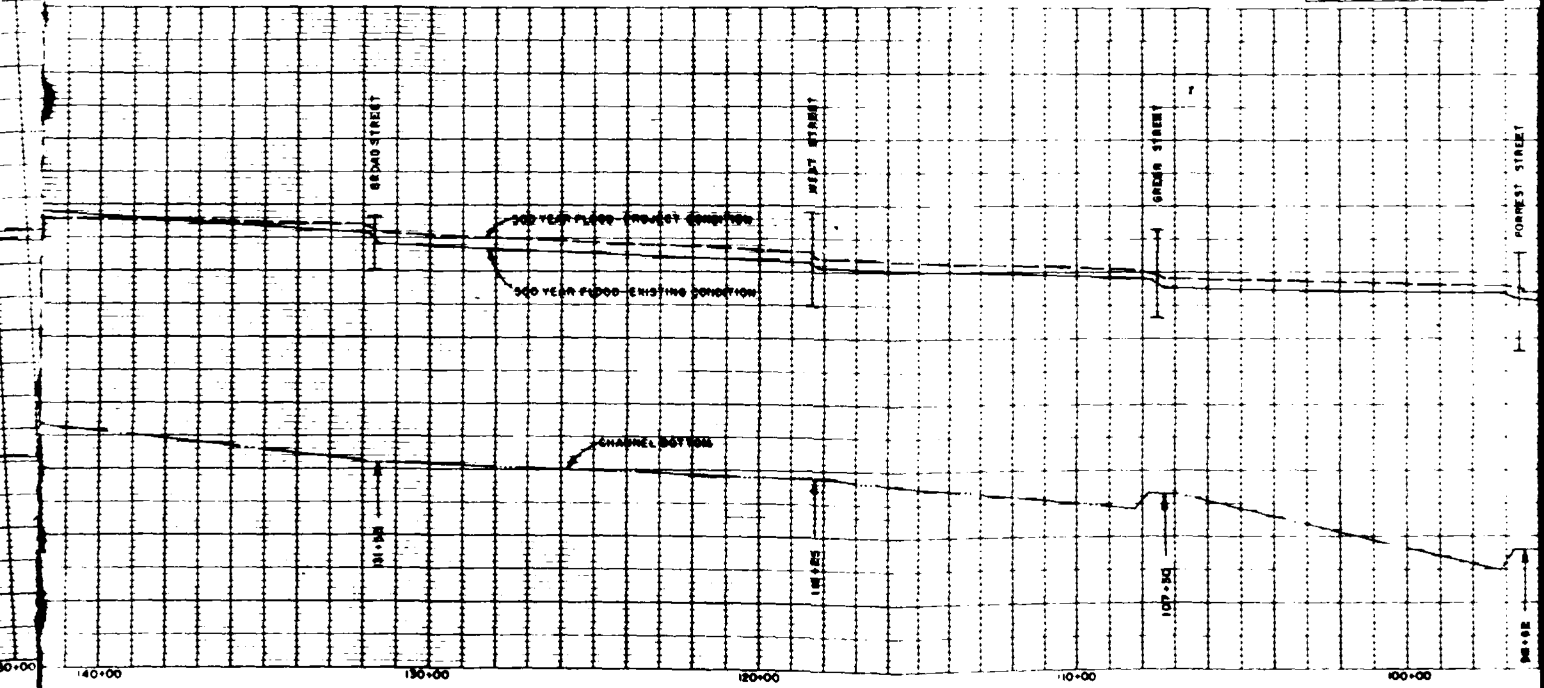
4

3





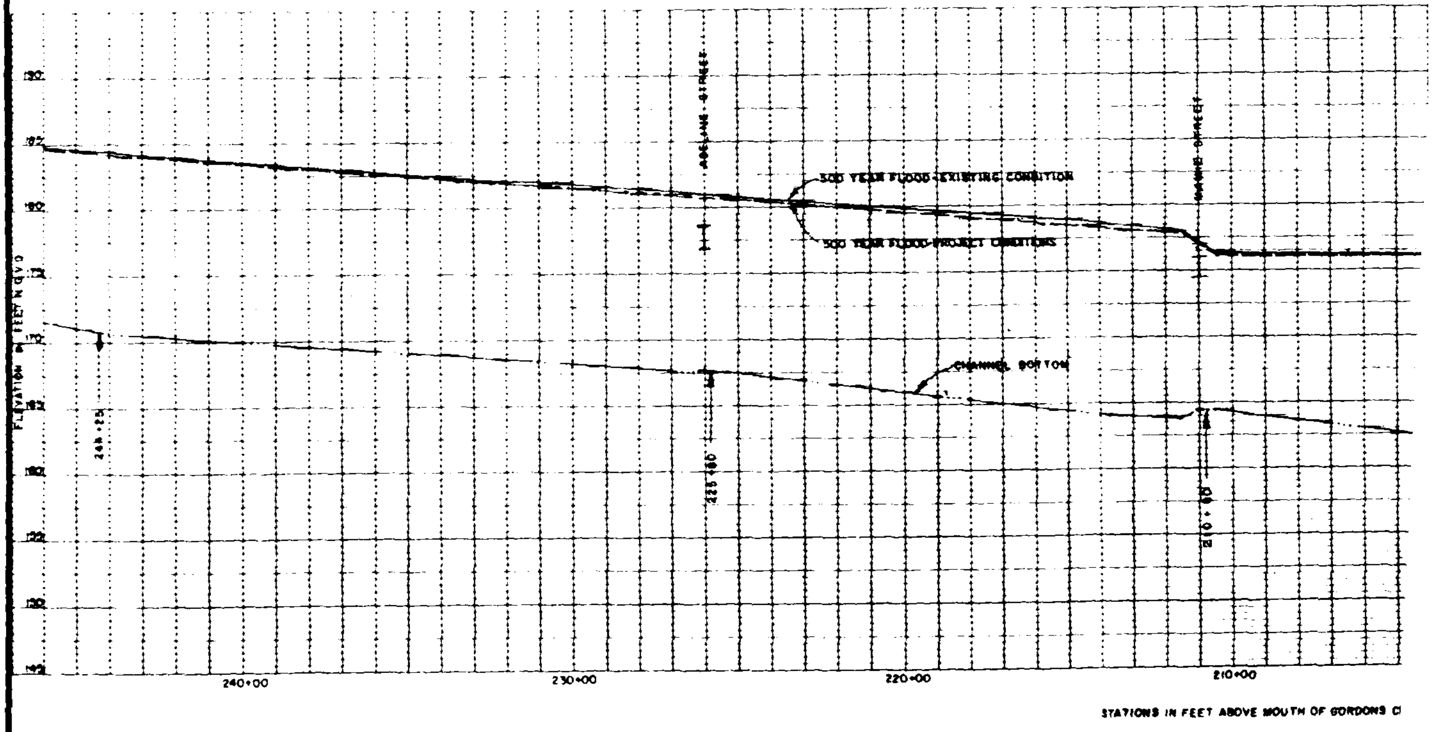
STATIONS IN FEET ABOVE MOUTH OF GORDONS CREEK

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

UPPER GORDONS CREEK FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI

500-YEAR FLOOD PROFILE
WITH AND WITHOUT PROJECT

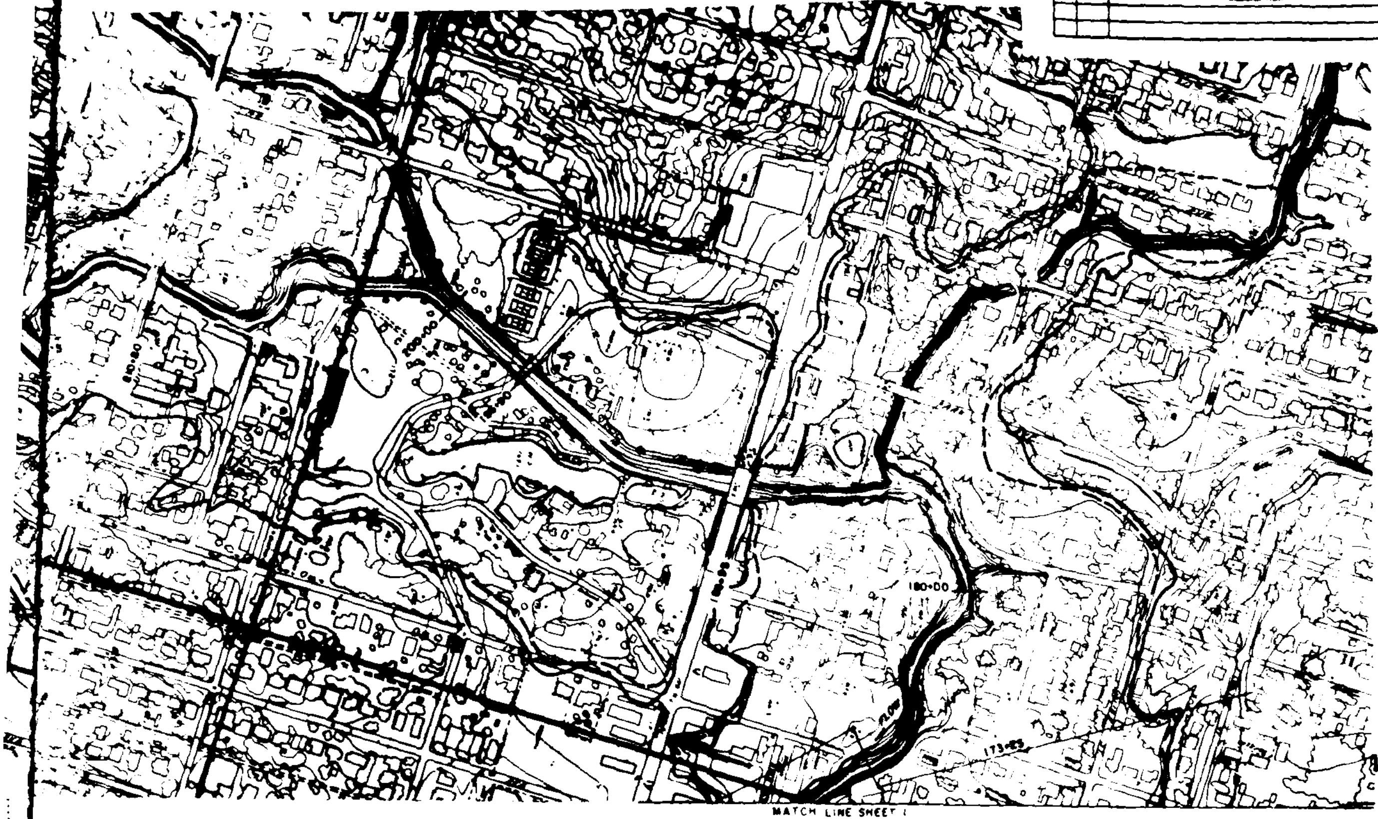
CORPS OF ENGINEERS | 4 | 3

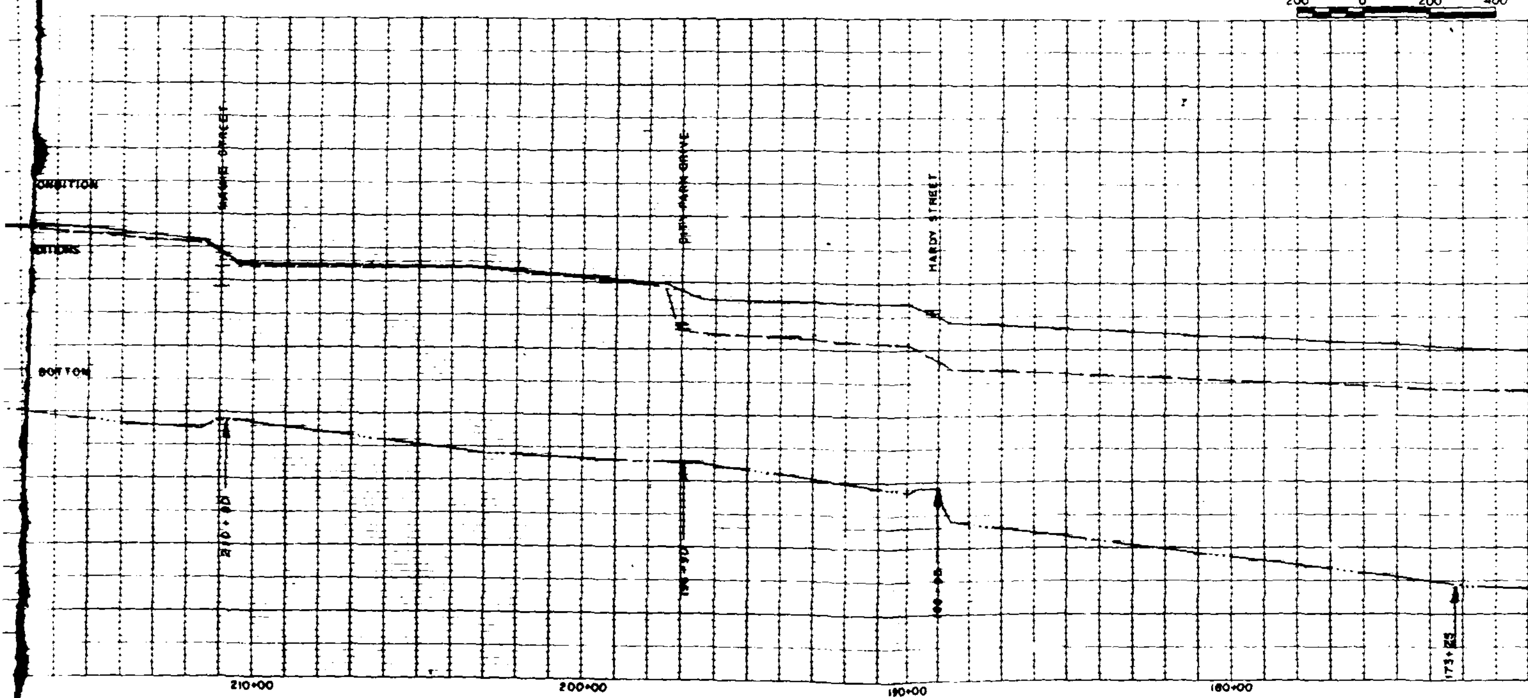


5 | 4 | 3

U. S. ARMY

REVISIONS





STATIONS IN FEET ABOVE MOUTH OF GORDONS CREEK

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

UPPER GORDONS CREEK FLOOD CONTROL STUDY

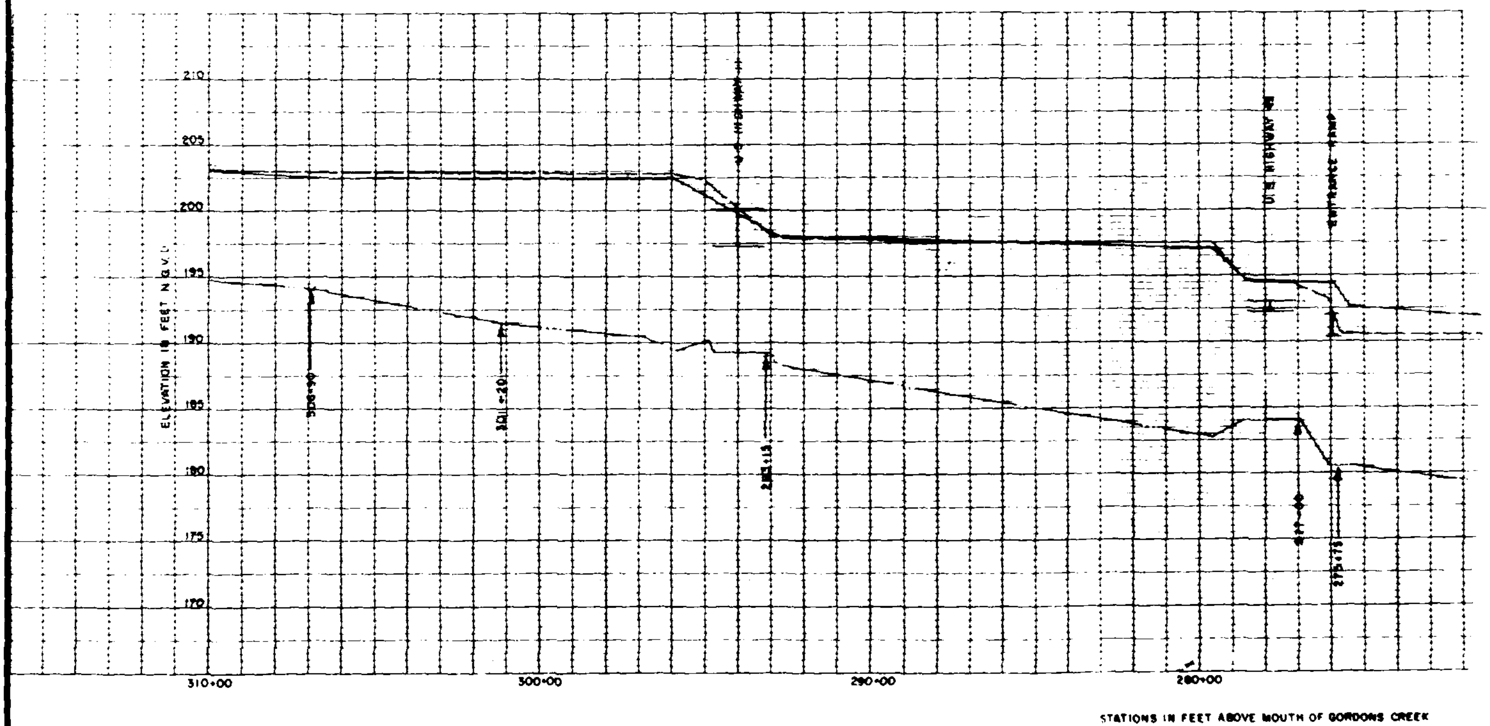
HATTIESBURG, MISSISSIPPI

500-YEAR FLOOD PROFILE
WITH AND WITHOUT PROJECT

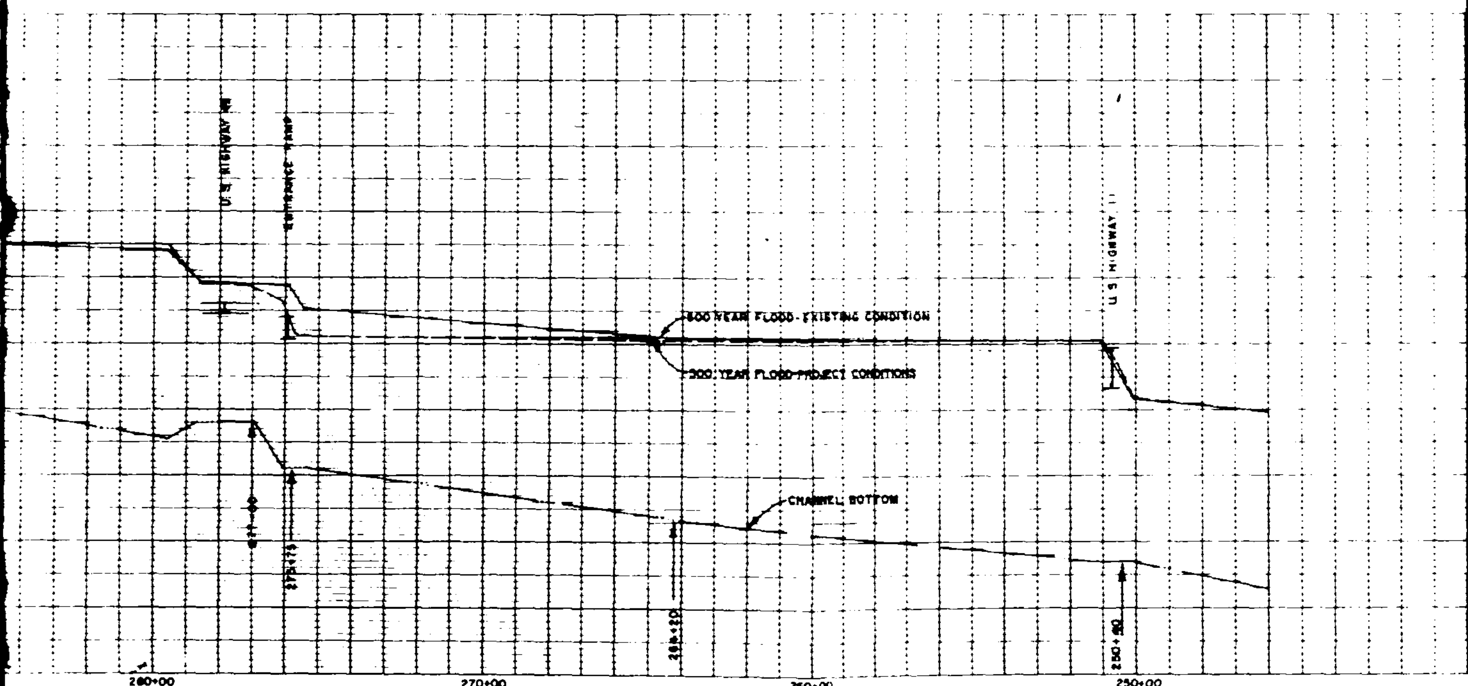
SHEET 2 OF 5

APPENDIX 2, CHART NO. 2-C-30

CORPS OF ENGINEERS | 4 | 3



5 | 4 | 3



STATIONS IN FEET ABOVE MOUTH OF GORDONS CREEK

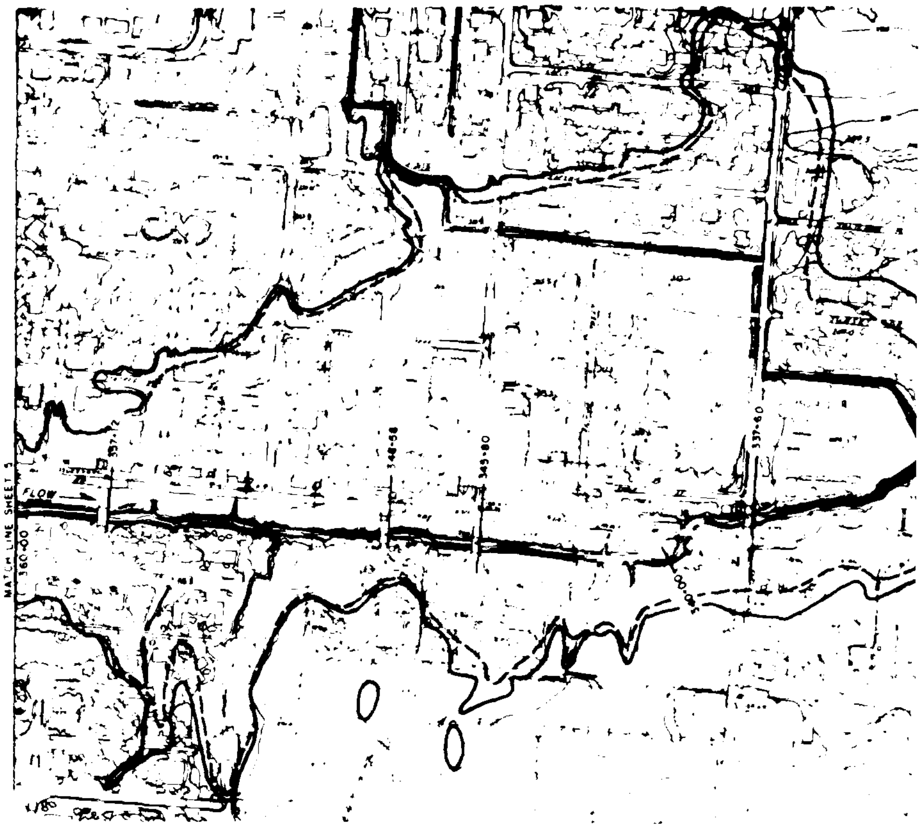
U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

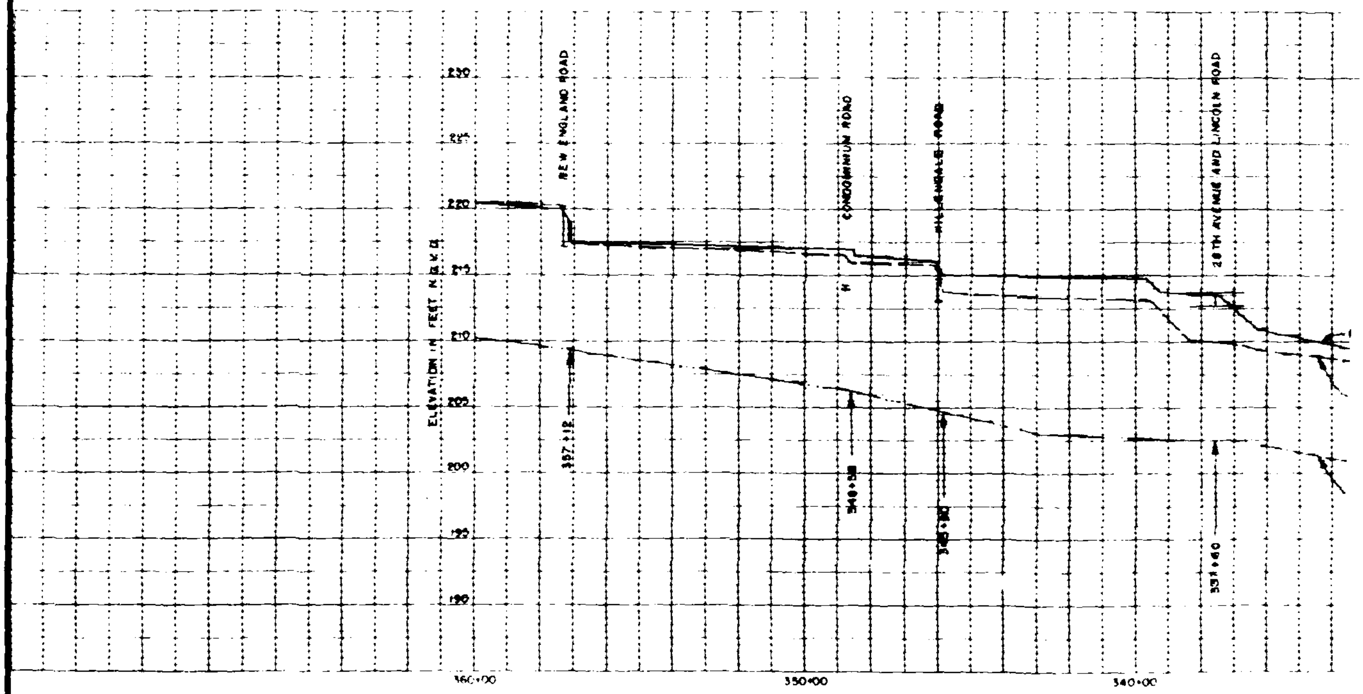
UPPER GORDONS CREEK FLOOD CONTROL STUDY

HAT ESBURG, MISSISSIPPI

500-YEAR FLOOD PROFILE
WITH AND WITHOUT PROJECT

SHEET 3 OF 5





STATIONS IN FEET ABOVE MOUTH OF G

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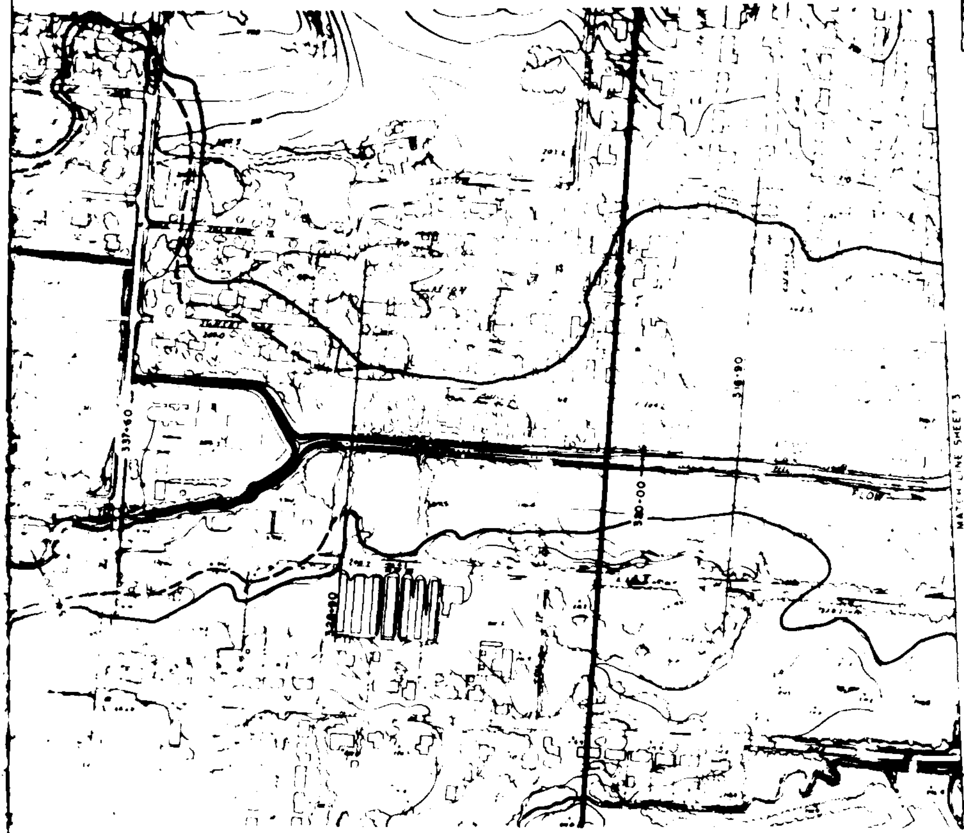

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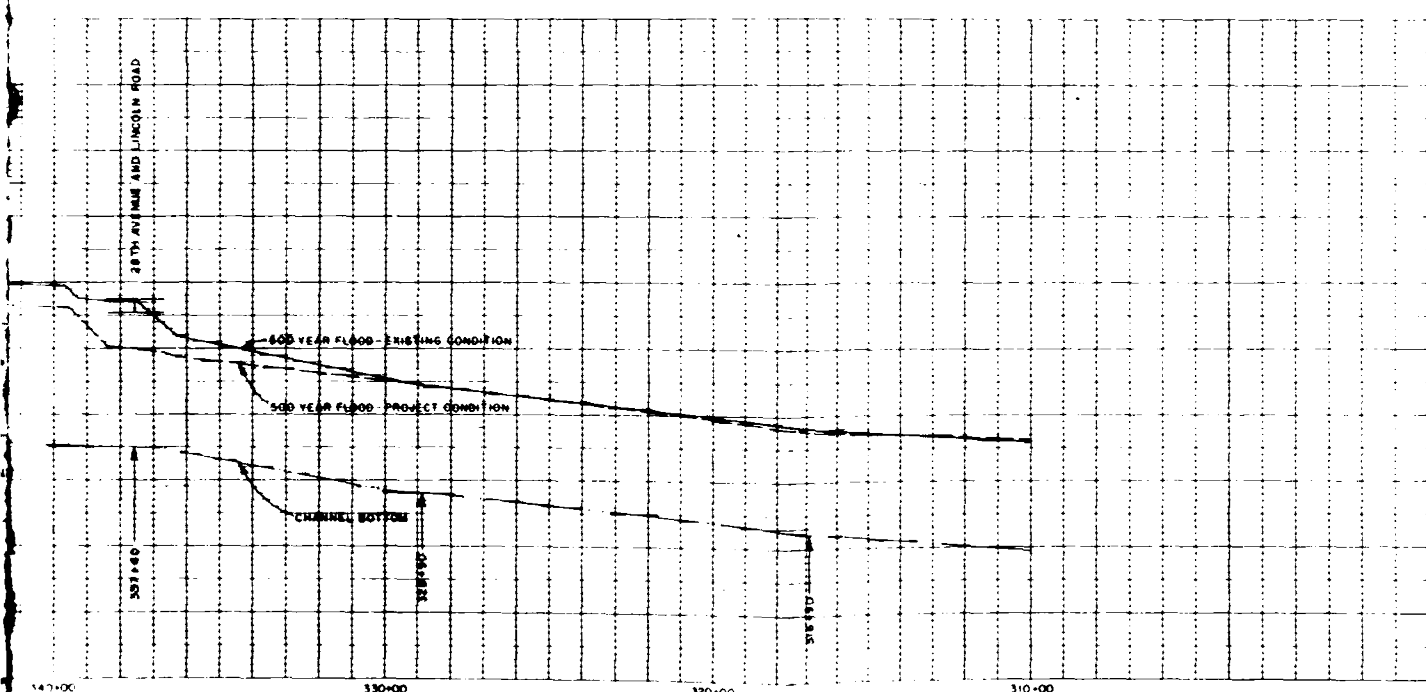

TATIONS IN FEET ABOVE MOUTH OF GORDONS CREEK

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

UPPER GORDONS CREEK FLOOD CONTROL STUDY

HATTIESBURG, MISSISSIPPI

500-YEAR FLOOD PROFILE.
WITH AND WITHOUT PROJECT

SPEC. NO. | FILE NO. | DRAWING NO. | SCALE | DATE | SHEET 4 OF 5

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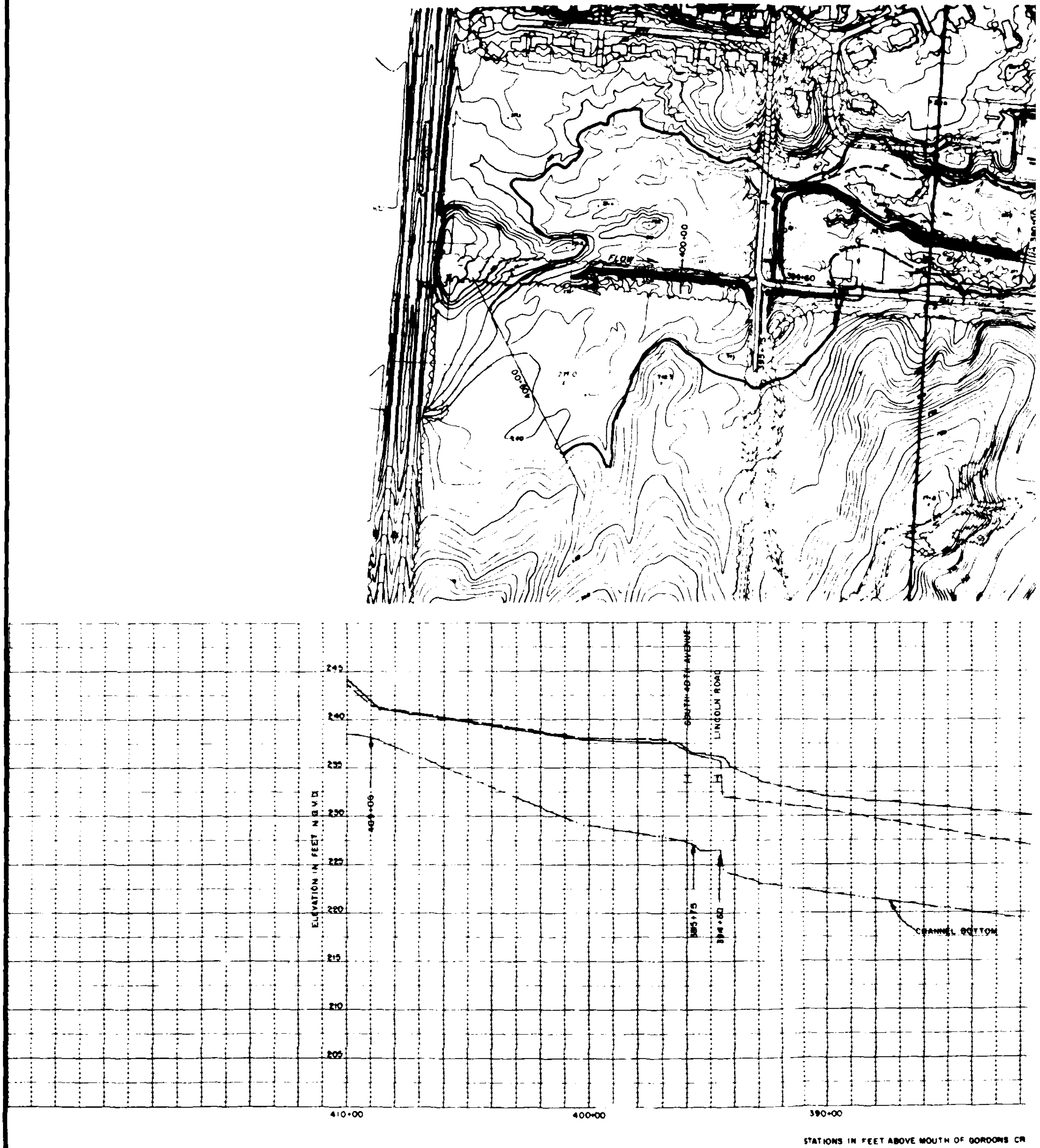

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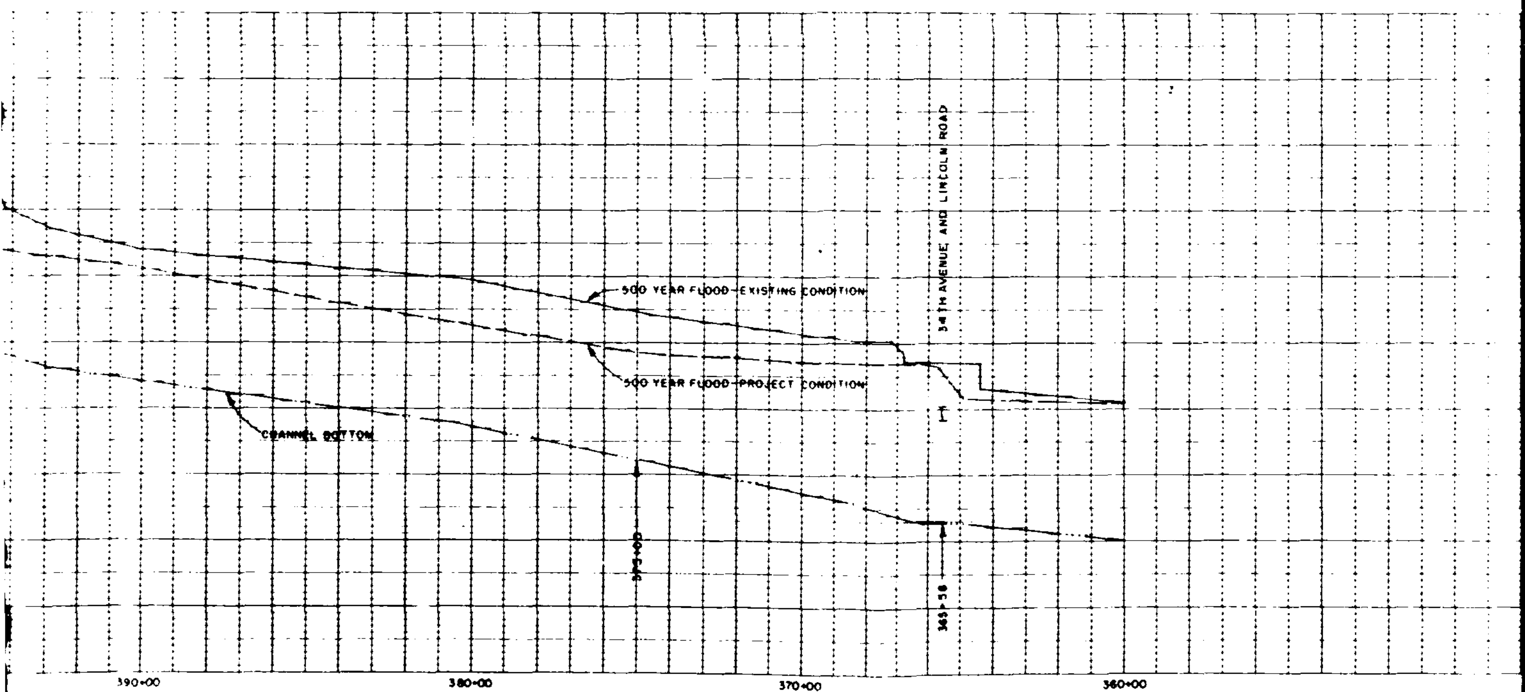


STATIONS IN FEET ABOVE MOUTH OF GORDONS CREEK

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

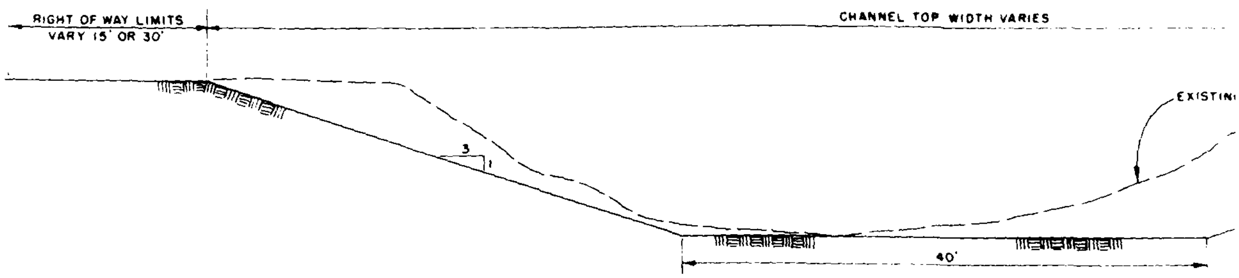
UPPER GORDONS CREEK FLOOD CONTROL STUDY

HATTIESBURG, MISSISSIPPI

500-YEAR FLOOD PROFILE
WITH AND WITHOUT PROJECT

SHEET 5 OF 5

APPENDIX 2, CHART NO 2-C-33



TYPICAL SECTION
BROAD STREET TO HARDY STREET

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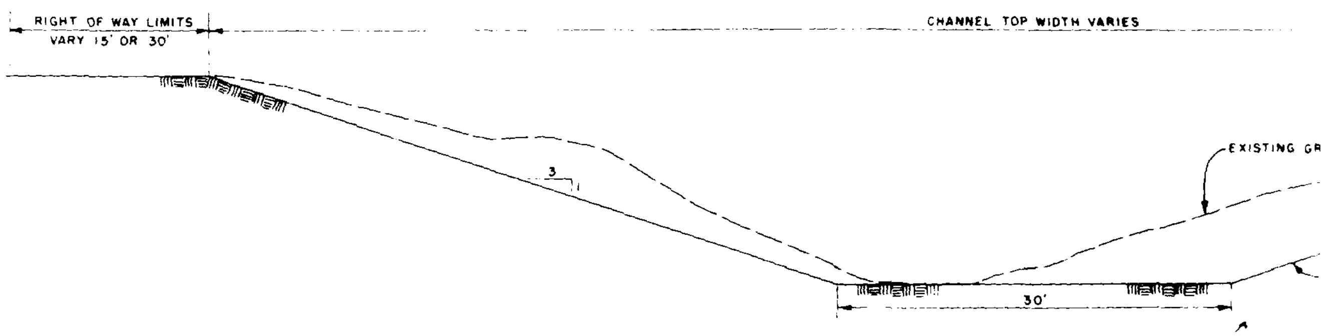

TYPICAL SECTION
UPSTREAM OF U.S. HWY 11 (250+40) TO 28th AVENUE

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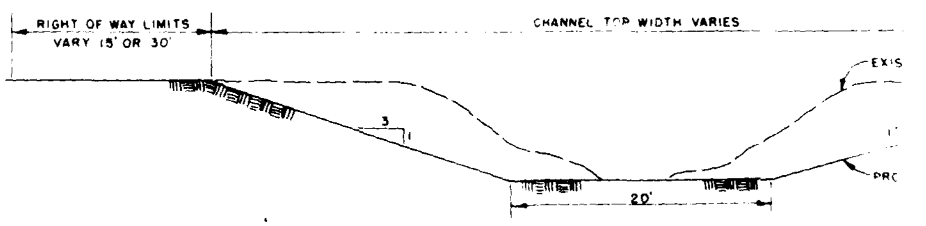

TYPICAL SECTION
28 TH AVENUE TO 40 TH AVENUE

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U. S. ARMY

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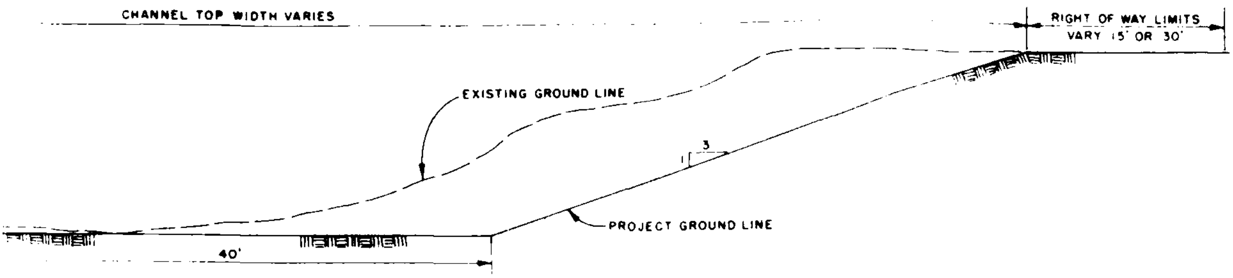

TYPICAL SECTION
BROAD STREET TO HARDY STREET

SCALE IN FEET

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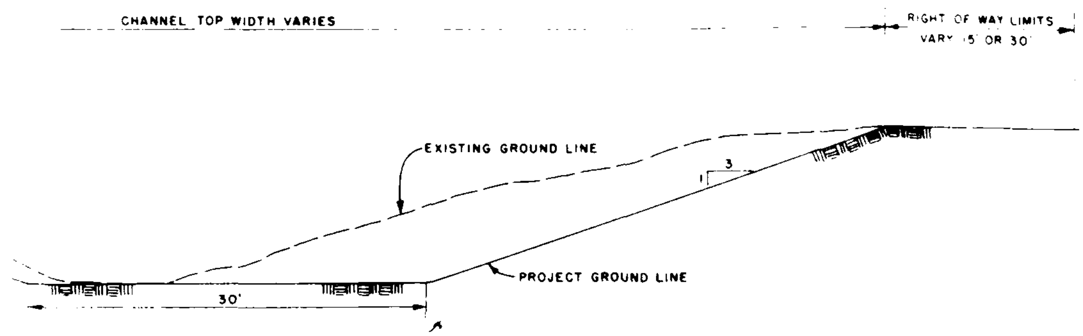

TYPICAL SECTION
UPSTREAM OF U.S. HWY 11 (250+40) TO 28th AVENUE

SCALE IN FEET

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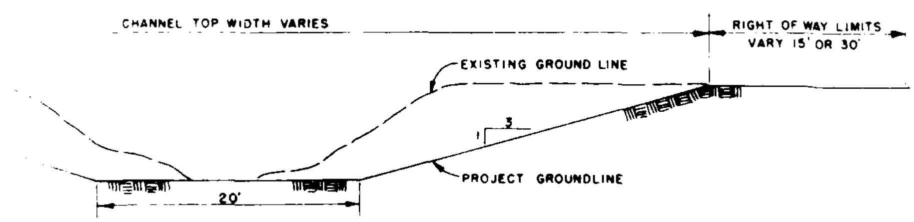

TYPICAL SECTION
28 TH AVENUE TO 40 TH AVENUE

SCALE IN FEET

5 0 5 10

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UPPER GORDONS CREEK FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
TYPICAL CHANNEL SECTIONS

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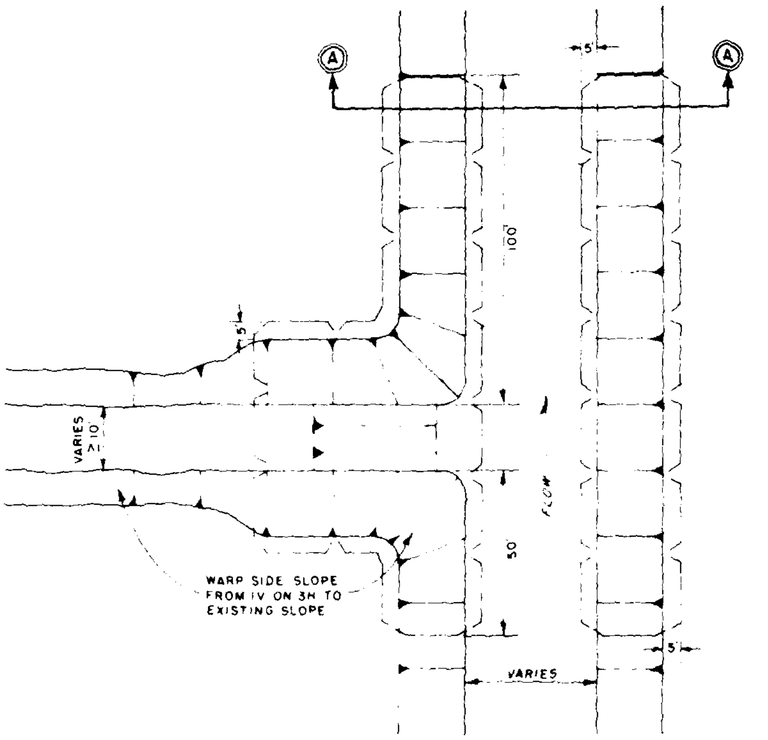

MAJOR DRAINAGE STRUCTURE

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SECTION A-A

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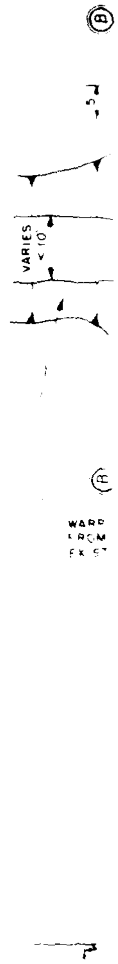

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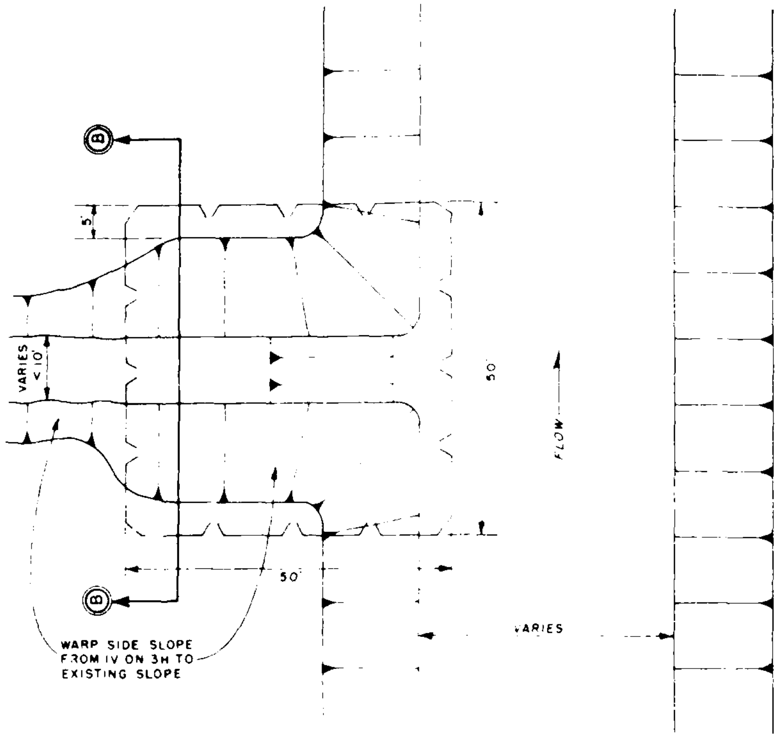

MINOR DRAINAGE STRUCTURE

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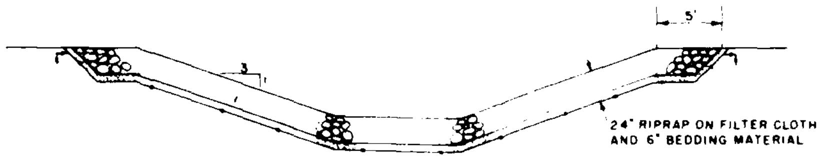

SECTION B-B
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U.S. ARMY ENGINEER DISTRICT, MOBILE
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UPPER GORDONS CREEK FLOOD CONTROL STUDY

HATTIESBURG, MISSISSIPPI

TYPICAL DRAINAGE STRUCTURES

SECTION D

GEOLOGIC AND SOILS INVESTIGATIONS

Introduction. The purpose of this section is to present a general description of the geologic and subsurface soil characteristics of the study area. The area consists of the portion of Gordons Creek from Broad Street upstream to South 40th Avenue and the alignment for a proposed diversion extending from Gordons Creek south to the Burketts Creek drainage basin in the vicinity of U.S. Highway 49. An existing Corps project has been constructed on Gordons Creek from the mouth upstream to Broad Street.

Extent of Study. Preliminary soils investigations along Upper Gordons Creek consisted of visual inspection of the bed and bank slope soils along the existing channel. Subsurface drilling was performed for the diversion consisting of five splitspoon borings along the proposed alignment. These investigations were made not as a final determination of foundation conditions for detailed design, but as a reasonable basis for design and evaluation of costs which could be expected with the various flood control plans formulated and investigated during the course of this study.

Geology and Soil Conditions. The Gordons creek drainage basin lies within the Long Leaf Pine Hills physiographic region of the East Gulf Coastal Plain Province. Exposed rock is of sedimentary deposition and unconsolidated. The exposed sediments range in age from Eocene to Recent with Miocene and younger sediments forming the majority of the exposed sediments. The geologic units have a regional southwestward dip of 20-45 feet per mile. Lithology varies between geologic units, but typically consists of interbedded clay, sand and gravel. The Hattiesburg formation of the Miocene age underlies Gordons Creek and has a thickness of over 100 feet in the project area. It is composed primarily of clay but also contains sand beds and occasional thin sandstone c siltstone beds.

Field surveys of the Upper Gordons Creek area showed that the bulk of the soil material forming the creek banks is soft to firm sandy clay silt (ML). Stable natural banks 10 to 15 feet high were observed with approximately one vertical on one horizontal and steeper slopes. The creek bed ranges from 15 to 40 feet in width and consists mainly of hard gray and brown claystone (CL). In some areas the claystone is overlain by sand sediments (SP) with depths ranging from one to two feet.

The investigation of the diversion alignment revealed that the subsurface conditions are typical of the general area with the predominant soils being loose to medium silty sands (SM) in the upper 10 to 12 feet of surface soils and fat clays (CH) beneath this layer. Soil design values have been assigned to each strata and are as follows:

Silty Sand (SM) $0 = 28^{\circ}$, $C = 0$

Clay (CH) $0 = 0$, $C = .75$ Tons per square foot

<u>Recommendations for Design</u>. Visual inspections of Upper Gordons Creek along with experience with the existing project indicates that a grassed channel can be designed to perform satisfactorily in the study area. Bank slopes no steeper than one vertical on three horizontal are recommended. Slopes to be riprapped should be no steeper than one vertical on two horizontal. The hard claystone in the creek bed is more resistant to erosion than the creek bank clay silt materials. However, the bed material can be excavated by dragline or other earthmoving equipment.

Preliminary investigation of the diversion alignment indicates that a diversion could be constructed without encountering rock excavation.

SECTION E

INTRODUCTION

A brief description and the estimated cost for implementation of the plans studied during preliminary and final plan formulation are presented in this section. This engineering data was developed to a level of detail consistent with the overall study effort and with the degree of accuracy necessary to assure creditable results.

COST ESTIMATES

Plan 13. Plan 13 consists of a plan for flood water diversion in the vicinity of U.S. Highway 49. The Plan would divert flood waters to a tributary of Burketts Creek named Burney Creek. A reinforced concrete box culvert, consisting of two 10 X 10-foot barrels, would extend from Gordons Creek south to Burney Creek and then turn east to cross Highway 49. The Culvert would be approximately 2200 feet long. On the east side of Highway 49, the culvert invert would be approximately eight feet below the existing invert of Burney Creek. From this point to approximately 3,300 feet downstream, a concrete lined channel would be constructed. The Plan 13 cost estimate was developed using November 1982 price levels.

TABLE 2-E-1
Cost Estimate for Plan 13
(Short Diversion Plan)

Item	Quantity	Unit	Unit Cost	Total Cost
FEDERAL FIRST COST				
Diversion				
Culvert Reach				
Clearing and Grubbing	4.5	Ac	$1,500.00	$6,800
Excavation	111,700	CY	2.50	279,300
Earth Fill	100,500	CY	3.00	301,500
Spoil Disposal	11,200	CY	4.50	50,400
Concrete	12,154	CY	160.00	1,944,600
Seeding and Mulching	4.5	Ac	2,300.00	10,400
Open Channel Reach				
Clearing and Grubbing	3.7	Ac	1,500.00	5,500
Concrete for Channel	2,065	CY	120.00	247,800
Concrete for Culverts	395	CY	200.00	79,000
Seeding and Mulching	3.0	Ac	2,300.00	6,900
Railroad Relocation	1	LS	100,000.00	$100,000
Subtotal				3,032,200
Contingencies (20%)				606,400
Total Construction Cost				3,638,600
Engineering and Design (8%)				291,100
Supervision and Administration (6%)				218,300
Total for Diversion				4,148,000
FEDERAL FIRST COST				$4,148,000
NON-FEDERAL FIRST COST				
Lands and Damages				
Land for Right-of-Way				
Structures to be Removed				
Land for Disposal Areas				
Contingencies (20%)				
Administrative Costs				
Total for Lands and Damages				Unknown
Relocations				
Bridge Modifications (4)		LS		315,300
Pipelines (16)		LS		91,700
Subtotal				407,000
Contingencies (20%)				81,400
Total for Relocations				488,400
NON-FEDERAL FIRST COST				$488,400
PROJECT COST (All First Costs Not Included)				$4,636,400

Plan 14. Plan 14 is a flood water diversion plan in the same location and with a culvert geometry identical to the culvert for Plan 13. However, in this plan the culvert is approximately twice as long. An open channel reach was not designed for this plan. The Plan 14 cost estimate was developed using November 1982 price levels.

TABLE 2-E-2
Cost Estimate for Plan 14
(Long Diversion Plan)

Item	Quantity	Unit	Unit Cost	Total Cost
FEDERAL FIRST COST				
Diversion				
Culvert Reach				
Clearing and Grubbing	11.0	Ac	$1,500.00	$16,500
Excavation	245,330	CY	2.50	613,300
Earth Fill	197,320	CY	3.00	592,000
Spoil Disposal	45,000	CY	4.50	202,500
Concrete	23,310	CY	160.00	3,729,600
Seeding and Mulching	11.0	Ac	2,300.00	25,300
Subtotal				$5,179,200
Open Channel Reach				
Clearing and Grubbing				
Concrete for the Channel				
Concrete for Culverts				
Seeding and Mulching				
Subtotal				Unknown
Railroad Relocation	1	LS	100,000.00	$100,000
Subtotal				5,279,200
Contingencies (20%)				1,055,800
Total Construction Cost				6,335,000
Engineering and Design (8%)				506,800
Supervision and Administration (6%)				380,100
Total for Diversion				7,221,900
FEDERAL FIRST COST				$7,221,900
NON-FEDERAL FIRST COST				
Lands and Damages				
Land for Right-of-Way				
Structures to be Removed				
Land for Disposal Areas				
Contingencies (20%)				
Administrative Costs				
Total for Property Acquisition				Unknown
Relocations				
Pipelines (10)		LS		62,100
Contingencies (20%)				12,400
Total for Relocations				74,500
NON-FEDERAL FIRST COST				$74,500
PROJECT COST (All First Costs Not Included)				$7,296,400

Plan 21. Plan 21 is a channel enlargement plan with a 40-foot bottom width channel and side slopes of one vertical on three horizontal extending 1.1 miles from the end of the existing project at Broad Street to the Hardy Street crossing of the creek. At Hardy Street the channel would be joined to an existing concrete lined channel that runs through Kamper Park. The Plan 21 cost estimate was developed using November 1982 price levels.

TABLE 2-E-3
Cost Estimate for Plan 21
(Channel Enlargement Broad Street to Hardy Street)

Item	Quantity	Unit	Unit Cost	Total Cost
FEDERAL FIRST COST				
Channel Enlargement				
Clearing and Grubbing	12.4	Ac	$1,500.00	$18,600
Disposal Area Clearing	2.0	Ac	1,500.00	3,000
Channel Excavation	77,480	CY	5.00	387,400
Riprap	4,128	CY	50.00	206,400
Bedding Material	1,706	CY	40.00	68,200
Filter Cloth	9,881	SY	3.00	29,600
Seeding and Mulching	12.4	Ac	2,300.00	28,500
Subtotal				741,700
Contingencies (20%)				148,300
Total Construction Cost				890,000
Engineering and Design (8%)				71,200
Supervision and Administration (6%)				53,400
Total for Channel Enlargement				1,014,600
FEDERAL FIRST COST				$1,014,600
NON-FEDERAL FIRST COST				
Lands and Damages				
Land for Right-of-Way	7.4	Ac	32,000.00	236,800
Structures to be Removed	3	Ea	38,070.00	114,200
Land for Disposal Areas	4.0	Ac	2,000.00	8,000
Subtotal				359,000
Contingencies (20%)				71,800
Administrative Costs (15%)				53,800
Total for Lands and Damages				484,600
Relocations				
Bridge Modifications		LS		0
Electric Lines (1)		LS		2,200
Pipelines (5)		LS		16,500
Subtotal				18,700
Contingencies (20%)				3,700
Total for Relocations				22,400
NON-FEDERAL FIRST COST				$507,000
TOTAL PROJECT COST				$1,521,600

Plan 22. Plan 22 consists of channel enlargement with the same cross section and alignment as Plan 21 between Broad Street and Kamper Park. An additional increment of work is added upstream of Kamper Park. A 40-foot bottom width channel with side slopes of one vertical on three horizontal extends from the existing concrete channel in the park upstream to U. S. Highway 49. The length of the additional channel is 1.4 miles and the total length of the work is 2.5 miles. The Plan 22 cost estimate was developed using November 1982 price levels.

TABLE 2-E-4
Cost Estimate for Plan 22
(Channel Enlargement Broad Street to Highway 49)

Item	Quantity	Unit	Unit Cost	Total Cost
FEDERAL FIRST COST				
Channel Enlargement				
Clearing and Grubbing	25.1	Ac	$1,350.00	$33,900
Disposal Area Clearing	4.8	Ac	1,500.00	7,200
Channel Excavation	184,620	CY	5.30	978,500
Riprap	8,991	CY	50.00	449,600
Bedding Material	3,990	CY	40.00	159,600
Filter Cloth	22,891	SY	3.00	68,700
Seeding and Mulching	25.1	Ac	2,300.00	57,700
Subtotal				1,755,200
Contingencies (20%)				351,000
Total Construction Cost				2,106,200
Engineering and Design (8%)				168,500
Supervision and Administration (6%)				126,400
Total for Channel Enlargement				2,401,100
FEDERAL FIRST COST				$2,401,100
NON-FEDERAL FIRST COST				
Lands and Damages				
Land for Right-of-Way	19.9	Ac	32,000.00	636,800
Structures to be Removed	4	Ea	39,650.00	158,600
Land for Disposal Areas	9.5	Ac	2,000.00	19,000
Subtotal				814,400
Contingencies (20%)				162,900
Administrative Costs (15%)				122,200
Total for Lands and Damages				1,099,500
Relocations				
Bridge Modifications		LS		0
Electric Lines (1)		LS		2,200
Pipelines (8)		LS		42,600
Subtotal				44,800
Contingencies (20%)				9,000
Total for Relocations				53,800
NON-FEDERAL FIRST COST				$1,153,300
TOTAL PROJECT COST				$3,554,400

Plan 23. Plan 23 consists of channel enlargement identical to Plan 22 except a 40-foot bottom width channel with side slopes of one vertical on three horizontal extends from the end of Plan 22 at U. S. Highway 49 to South 28th Avenue. The additional channel is 1.1 miles long and the total length of the work is 3.6 miles. The Plan 23 cost estimate was developed using November 1982 price levels.

TABLE 2-E-5
Cost Estimate for Plan 23
(Channel Enlargement Broad Street to 28th Avenue)

Item	Quantity	Unit	Unit Cost	Total Cost
FEDERAL FIRST COST				
Channel Enlargement				
Clearing and Grubbing	34.6	Ac	$1,390.00	$48,100
Disposal Area Clearing	6.0	Ac	1,500.00	9,000
Channel Excavation	231,160	CY	5.43	1,255,200
Riprap	11,256	CY	50.00	562,800
Bedding Material	4,607	CY	40.00	184,300
Filter Cloth	26,401	SY	3.00	79,200
Seeding and Mulching	34.6	Ac	2,300.00	79,600
Subtotal				2,218,200
Contingencies (20%)				443,600
Total Construction Cost				2,661,800
Engineering and Design (8%)				212,900
Supervision and Administration (6%)				159,700
Total for Channel Enlargement				3,034,400
FEDERAL FIRST COST				$3,034,400
NON-FEDERAL FIRST COST				
Lands and Damages				
Land for Right-of-Way	28.2	Ac	36,720.00	1,035,500
Structures to be Removed	8	Ea	42,440.00	339,500
Land for Disposal Areas	11.9	Ac	2,000.00	23,800
Subtotal				1,398,800
Contingencies (20%)				279,800
Administrative Costs (15%)				209,800
Total for Lands and Damages				1,888,400
Relocations				
Bridge Modifications		LS		0
Electric Lines (1)		LS		2,200
Pipelines (10)		LS		50,400
Subtotal				52,600
Contingencies (20%)				10,500
Total for Relocations				63,100
NON-FEDERAL FIRST COST				$1,951,500
TOTAL PROJECT COST				$4,985,900

Plan 24. Plan 24 consists of channel enlargement with the same dimensions and limits as Plan 23 downstream of South 28th Avenue. An increment of work consisting of a 30-foot bottom width channel with side slopes of one vertical on three horizontal is added between South 28th Avenue and the intersection of South 40th Avenue and Lincoln Road. The additional channel is 1.1 miles long and the total length of the work is 4.7 miles. The Plan 24 cost estimate was developed using November 1982 price levels.

TABLE 2-E-6
Cost Estimate for Plan 24
(Channel Enlargement Broad Street to 40th Avenue)

Item	Quantity	Unit	Unit Cost	Total Cost
FEDERAL FIRST COST				
Channel Enlargement				
Clearing and Grubbing	43.2	Ac	$1,340.00	$57,900
Disposal Area Clearing	7.2	Ac	1,500.00	10,800
Channel Excavation	280,340	CY	5.62	1,575,500
Riprap	15,559	CY	50.00	778,000
Bedding Material	5,754	CY	40.00	230,200
Filter Cloth	32,987	SY	3.00	99,000
Seeding and Mulching	43.2	Ac	2,300.00	99,400
Subtotal				2,850,800
Contingencies (20%)				570,200
Total Construction Cost				3,421,000
Engineering and Design (8%)				273,700
Supervision and Administration (6%)				205,300
Total for Channel Enlargement				3,900,000
FEDERAL FIRST COST				$3,900,000
NON-FEDERAL FIRST COST				
Lands and Damages				
Land for Right-of-Way	37.2	Ac	45,790.00	1,703,400
Structures to be Removed	8	Ea	42,440.00	339,500
Land for Disposal Areas	14.5	Ac	2,000.00	29,000
Subtotal				2,071,900
Contingencies (20%)				414,400
Administrative Costs (15%)				310,800
Total for Lands and Damages				2,797,100
Relocations				
Bridge Modifications (2)		LS		340,000
Electric Lines (1)		LS		2,200
Pipelines (19)		LS		84,500
Subtotal				426,700
Contingencies (20%)				85,300
Total for Relocations				512,000
NON-FEDERAL FIRST COST				$3,309,100
TOTAL PROJECT COST				$7,209,100

Plan 25. Plan 25 combines Plan 24 with a 30-foot bottom width channel that has side slopes of one vertical on three horizontal on the tributary entering Gordons Creek at Kamper Park. The additional work begins at the end of the concrete channel in Kamper Park and extends upstream 0.6 miles to U.S. Highway 49. The total length of the work for this plan is 5.3 miles. The Plan 25 cost estimate was developed using November 1982 price levels.

TABLE 2-E-7
Cost Estimate for Plan 25
(Main Creek and Kamper Park to Highway 49 on the Tributary)

Item	Quantity	Unit	Unit Cost	Total Cost
FEDERAL FIRST COST				
Channel Enlargement				
Clearing and Grubbing	49.8	Ac	$1,365.00	$68,000
Disposal Area Clearing	8.4	Ac	1,500.00	12,600
Channel Excavation	325,590	CY	5.60	1,823,300
Riprap	16,203	CY	50.00	810,200
Bedding Material	6,075	CY	40.00	243,000
Filter Cloth	34,850	SY	3.00	104,600
Seeding and Mulching	49.8	Ac	2,300.00	114,500
Subtotal				3,176,200
Contingencies (20%)				635,200
Total Construction Cost				3,811,400
Engineering and Design (8%)				304,900
Supervision and Administration (6%)				228,700
Total for Channel Enlargement				4,345,000
FEDERAL FIRST COST				$4,345,000
NON-FEDERAL FIRST COST				
Lands and Damages				
Land for Right-of-Way	44.4	Ac	44,490.00	1,975,400
Structures to be Removed	24	Ea	43,050.00	1,033,200
Land for Disposal Areas	16.8	Ac	2,000.00	33,600
Subtotal				3,042,200
Contingencies (20%)				608,400
Administrative Costs (15%)				456,300
Total for Lands and Damages				4,106,900
Relocations				
Bridge Modifications (3)		LS		362,500
Electric Lines (1)		LS		2,200
Pipelines (24)		LS		113,900
Subtotal				478,600
Contingencies (20%)				95,700
Total for Relocations				574,300
NON-FEDERAL FIRST COST				$4,681,200
TOTAL PROJECT COST				$9,026,200

Plan 26. Plan 26 contains all the elements of Plan 25 with a 20-foot bottom width channel and side slopes of one vertical on three horizontal extending from U.S. Highway 49 to South 34th Avenue. The additional channel is 1.1 miles and the total length of the work is 6.4 miles. The Plan 26 cost estimate was developed using November 1982 price levels.

TABLE 2-E-8
Cost Estimate for Plan 26
(Main Creek and Kamper Park to 34th Avenue on the Tributary)

Item	Quantity	Unit	Unit Cost	Total Cost
FEDERAL FIRST COST				
Channel Enlargement				
Clearing and Grubbing	57.7	Ac	$1,360.00	$78,500
Disposal Area Clearing	9.4	Ac	1,500.00	14,100
Channel Excavation	362,590	CY	5.64	2,045,000
Riprap	17,680	CY	50.00	884,000
Bedding Material	6,814	CY	40.00	272,600
Filter Cloth	39,155	SY	3.00	117,500
Seeding and Mulching	57.7	Ac	2,300.00	132,700
Subtotal				3,544,400
Contingencies (20%)				708,900
Total Construction Cost				4,253,300
Engineering and Design (8%)				340,300
Supervision and Administration (6%)				255,200
Total for Channel Enlargement				4,848,800
FEDERAL FIRST COST				$4,848,800
NON-FEDERAL FIRST COST				
Lands and Damages				
Land for Right-of-Way	52.8	Ac	45,050.00	2,378,600
Structures to be Removed	26	Ea	45,570.00	1,184,800
Land for Disposal Areas	18.7	Ac	2,000.00	37,400
Subtotal				3,600,800
Contingencies (20%)				720,200
Administrative Costs (15%)				540,100
Total for Lands and Damages				4,861,100
Relocations				
Bridge Modifications (4)		LS		382,500
Electric Lines (1)		LS		2,200
Pipelines (27)		LS		132,000
Subtotal				516,700
Contingencies (20%)				103,300
Total for Relocations				620,000
NON-FEDERAL FIRST COST				$5,481,100
TOTAL PROJECT COST				$10,329,900

Plan 24A. Plan 24A is a channel enlargement plan which is a modification of Plan 24. It consists of a 40-foot bottom width channel extending from Broad Street to Kamper Park as in Plan 24. The bottom width of the segment of work between Kamper Park and South 28th Avenue is reduced from 40 feet to 30 feet. The channel bottom width is also 30 feet between South 28th Avenue and the intersection of South 40th Avenue and Lincoln Road as in Plan 24. The Plan 24A cost estimate was developed using November 1982 price levels.

TABLE 2-E-9
Cost Estimate for Plan 24A
(Channel Enlargement Broad Street to 40th Avenue)

Item	Quantity	Unit	Unit Cost	Total Cost
FEDERAL FIRST COST				
Channel Enlargement				
Clearing and Grubbing	43.2	Ac	$1,340.00	$57,900
Disposal Area Clearing	5.8	Ac	1,500.00	8,700
Channel Excavation	225,260	CY	5.60	1,261,500
Riprap	15,406	CY	50.00	770,300
Bedding Material	5,704	CY	40.00	228,200
Filter Cloth	32,680	SY	3.00	98,000
Seeding and Mulching	43.2	Ac	2,300.00	99,400
Subtotal				2,524,000
Contingencies (20%)				504,800
Total Construction Cost				3,028,800
Engineering and Design (8%)				242,300
Supervision and Administration (6%)				181,700
Total for Channel Enlargement				3,452,800
FEDERAL FIRST COST				$3,452,800
NON-FEDERAL FIRST COST				
Lands and Damages				
Land for Right-of-Way	34.4	Ac	46,320.00	1,593,400
Structures to be Removed	8	Ea	42,440.00	339,500
Land for Disposal Areas	11.6	Ac	2,000.00	23,200
Subtotal				1,956,100
Contingencies (20%)				391,200
Administrative Costs (15%)				293,400
Total for Lands and Damages				2,640,700
Relocations				
Bridge Modifications (2)		LS		340,000
Electric Lines (1)		LS		2,200
Pipelines (19)		LS		84,500
Subtotal				426,700
Contingencies (20%)				85,300
Total for Relocations				512,000
NON-FEDERAL FIRST COST				$3,152,700
TOTAL PROJECT COST				$6,605,500

Plan 24B. Plan 24B is a channel enlargement plan which is also a modification of Plan 24. Plan 24B includes a channel with the same cross section and limits of work as Plan 24A between Broad Street and South 28th Avenue. The segment of work between South 28th Avenue and the intersection of South 40th Avenue and Lincoln Road is reduced from a 30 foot bottom width to a 20 foot bottom width. Therefore, in relation to Plan 24, this plan consists of a 10 foot reduction in bottom width for all work upstream of Kamper Park. The Plan 24B cost estimate was developed using November 1982 price levels.

TABLE 2-E-10
Cost Estimate for Plan 24B
(Channel Enlargement Broad Street to 40th Avenue)

Item	Quantity	Unit	Unit Cost	Total Cost
FEDERAL FIRST COST				
Channel Enlargement				
Clearing and Grubbing	43.2	Ac	$1,340.00	$57,900
Disposal Area Clearing	5.4	Ac	1,500.00	8,100
Channel Excavation	213,700	CY	5.55	1,186,000
Riprap	15,406	CY	50.00	770,300
Bedding Material	5,704	CY	40.00	228,200
Filter Cloth	32,680	SY	3.00	98,000
Seeding and Mulching	43.2	Ac	2,300.00	99,400
Subtotal				2,447,900
Contingencies (20%)				489,600
Total for Channel				2,937,500
Engineering and Design (8%)				235,000
Supervision and Administration (6%)				176,200
FEDERAL FIRST COST				$3,348,700
NON-FEDERAL FIRST COST				
Lands and Damages				
Land for Right-of-Way	33.1	Ac	45,230.00	1,497,100
Structures to be Removed	7	Ea	48,500.00	339,500
Land for Disposal Areas	10.8	Ac	2,000.00	21,600
Subtotal				1,858,200
Contingencies (20%)				371,600
Admininstrative Costs (15%)				278,700
Total for Lands and Damages				2,508,500
Relocations				
Bridge Modification (2)		LS		86,800
Electric Lines (1)		LS		2,200
Pipelines (19)		LS		84,500
Subtotal				173,500
Contingencies (20%)				34,700
Total for Relocations				208,200
TOTAL NON-FEDERAL COST				$2,716,700
TOTAL PROJECT COST				$6,065,400

Plan 31. Plan 31 consists of the evacuation of all structures affected by the 10-year frequency flood. The plan consists of the evacuation of 162 residences and 10 commercial structures. The Plan 31 cost estimate was developed using November 1982 price levels.

TABLE 2-E-11
Cost Estimate for Plan 31
(Flood Plain Evacuation)

Item	Quantity	Unit	Unit Cost	Total Cost
Property Acquisition				
Value of Land and Structures	172	Ea	Varies	$10,756,900
Contingencies (20%)		LS		2,151,400
Administrative Costs	172	Ea	$3,000.00	516,000
Total for Property Acquisition				$13,424,300
Demolition and Site Reclamation				
Remove Structures	172	Ea	1,500.00	258,000
Remove Utilities	172	Ea	800.00	137,600
Remove Foundations	172	Ea	600.00	103,200
Grade and Grass Site	172	Ea	500.00	86,000
Subtotal				584,800
Contingencies (20%)				117,000
Total for Demolition and Site Reclamation				$701,800
Salvageable Items	172	Ea	-5000.00	(860,000)
TOTAL PROJECT COST				$13,266,100
FEDERAL FIRST COST (80%)				$10,612,900
NON-FEDERAL FIRST COST (20%)				$2,653,200

Plan 32. Plan 32 consists of the removal of the maximum number of structur that are feasible in flood plain areas along the creek. Eighteen structure within the 10-year flood plain were feasible for evacuation. The Plan 32 c estimate was developed using November 1982 price levels.

TABLE 2-E-12
Cost Estimate for Plan 32
(Flood Plain Evacuation)

Item	Quantity	Unit	Unit Cost	Total Cost
Property Acquisition				
Value of Land and Structures	18	Ea	Varies	$1,157,900
Contingencies (20%)				231,600
Administrative Costs	18	Ea	$3,000.00	54,000
Total for Property Acquisition				$1,443,500
Demolition and Site Reclamation				
Remove Structures	18	Ea	1,500.00	27,000
Remove Utilities	18	Ea	800.00	14,400
Remove Foundations	18	Ea	600.00	10,800
Grade and Grass Site	18	Ea	500.00	9,000
Subtotal				61,200
Contingencies (20%)				12,200
Total for Demolition and Site Reclamation				$73,400
Salvageable Items	18	Ea	-5000.00	(90,000)
TOTAL PROJECT COST				$1,426,900
TOTAL FEDERAL FIRST COST (80%)				$1,141,500
TOTAL NON-FEDERAL FIRST COST (20%)				$285,400

Plan 24B (Revised). Plan 24B was refined for detailed design. These refinements included increased right-of-way and tree plantings at selected locations to mitigate environmental impacts of the plan. A study was made and a plan was recommended to the local sponsor to mitigate the flood damage impacts on the existing project. Modifications were made in two bridges. A more detailed estimate was made of lands and damages costs. This Plan 24B cost estimate was developed using October 1985 price levels.

TABLE 2-E-13
Detailed Cost Estimate for Plan 24B (Revised)
(October 1985 Price Levels)

Item	Quantity	Unit	Unit Cost	Total Cost
STRUCTURAL COMPONENT				
Project Construction				
Channel Enlargement				
Clearing and Grubbing	33.6	Ac	$1,400.00	$47,000
Disposal Area Clearing	5.4	Ac	1,500.00	8,100
Channel Excavation	213,700	CY	5.55	1,186,000
Riprap	16,560	CY	50.00	828,000
Bedding Material	6,240	CY	40.00	249,600
Filter Cloth	35,740	SY	3.00	107,200
Seeding and Mulching	32.6	Ac	2,300.00	75,000
Drainage Structures (11)		LS		186,900
Contingencies (20%)		LS		537,600
Total Construction Cost				3,225,400
Engineering and Design (8%)				258,000
Supervision and Administration (6%)				193,500
Total for Channel Enlargement				3,676,900
Total Cost for Project Construction				$3,676,900
Lands, Damages, and Relocations				
Lands and Damages				
Land for Right-of-Way	65.1	Ac	19,808.00	1,289,500
Severance Damages (40 structures)		LS		513,700
Structures to be Removed (11)		LS		430,500
Land for Disposal Areas	10.8	Ac	2,000.00	21,600
Contingencies (20%)		LS		451,100
Administrative Costs	215	Ea	4,000.00	860,000
Total for Lands and Damages				3,566,400
Relocations				
Bridge Modifications (2)		LS		216,800
Electric Lines		LS		2,200
Pipelines (19)		LS		84,500
Contingencies (20%)		LS		60,700
Total for Relocations				364,200
Total Cost for Lands, Damages, and Relocations				$3,930,600

TABLE 2-E-13 (Continued)
Detailed Cost Estimate for Plan 24B (Revised)
(October 1985 Price Levels)

Item	Quantity	Unit	Unit Cost	Total Cost
		MITIGATION COMPONENT		
Habitat Mitigation				
Land for Right-of-Way	3.7	Ac	$19,808.00	$73,300
Tree Plantings		LS		12,000
Contingencies (20%)		LS		17,100
Total Cost for Habitat Mitigation				102,400
Mitigation of Induced Flood Damages				
Raising Structures in Place				
Elevating the Structure	21	Ea	$2,100.00	$44,100
Foundation Work	21	Ea	2,000.00	42,000
Landscaping	21	Ea	1,000.00	21,000
Temporary Housing	21	Ea	500.00	10,500
Subtotal for Raising Structures in Place				117,600
Sealing One Structure				
Concrete	133.0	CY	200.00	26,600
Excavation	800	CY	5.50	4,400
Earth Fill	800	CY	6.50	5,200
Interior Drainage		LS		600
Sewer Modifications		LS		500
Landscaping		LS		1,500
Subtotal for Sealing One Structure				38,800
Contingencies (25%)				39,100
Total Construction Cost				195,500
Engineering and Design (10%)				19,500
Supervision and Administration (8%)				15,600
Total Cost for Mitigation of Induced Flood Damages				230,600
TOTAL COST FOR STRUCTURAL COMPONENT				$7,607,500
TOTAL COST FOR MITIGATION COMPONENT				$333,000
TOTAL PROJECT FIRST COST				$7,940,500

Plan 27. Plan 27 consists of channel enlargement with the same bottom widths and side slopes as Plan 24B. The limits of work extend from Broad Street to Fortieth Avenue in a similar manner as Plan 24B except no work would be performed in the portion of the stream between Kamper Park and Broadway Drive (U.S. Highway 11). Eight residences on Brooklane Street and one residence on South 17th Avenue were found to be feasible for evacuation and are included in the plan. The Plan 27 cost estimate was developed using October 1985 price levels.

TABLE 2-E-14
Detailed Cost Estimate for Plan 27
(October 1985 Price Levels)

Item	Quantity	Unit	Unit Cost	Total Cost
STRUCTURAL COMPONENT				
Project Construction				
Channel Enlargement				
Clearing and Grubbing	28.0	Ac	$1,300.00	$36,400
Disposal Area Clearing	4.4	Ac	1,500.00	6,600
Channel Excavation	170,700	CY	5.56	949,100
Riprap	12,830	CY	50.00	641,500
Bedding Material	4,490	CY	40.00	179,600
Filter Cloth	25,770	SY	3.00	77,300
Seeding and Mulching	28.0	Ac	2,300.00	64,400
Drainage Structures (7)		LS		139,900
Contingencies (20%)		LS		419,000
Total Construction Cost				2,513,800
Engineering and Design (8%)				201,400
Supervision and Administration (6%)				150,800
Total for Channel Enlargement				2,866,000
Total Cost for Project Construction				$2,866,000
Lands, Damages, and Relocations				
Lands and Damages				
Land for Right-of-Way	53.8	Ac	18,680.00	1,005,000
Severance Damages		LS		393,400
Structures to be Removed		LS		348,500
Land for Disposal Areas	8.8	Ac	2,000.00	17,600
Contingencies (20%)		LS		352,900
Administrative Costs	139	Ea	4,000.00	556,000
Total for Lands and Damages				2,673,400
Relocations				
Bridge Modifications (2)		LS		216,800
Electric Lines		LS		2,200
Pipelines (18)		LS		80,200
Contingencies (20%)		LS		59,800
Total for Relocations				359,000
Total Cost for Lands, Damages, and Relocations				$3,032,400

TABLE 2-E-14 (Continued)

Detailed Cost Estimate for Plan 27
(October 1985 Price Levels)

Item	Quantity	Unit	Unit Cost	Total Cost
NONSTRUCTURAL COMPONENT				
Flood Plain Evacuation				
Property Acquisition				
Value of Land and Structures	9	Ea	Varies	$309,600
Contingencies (20%)		LS		61,900
Administrative Costs	9	Ea	$4,000.00	36,000
Total for Property Acquisition				$407,500
Demolition and Site Reclamation				
Remove Structures	9	Ea	1,500.00	13,500
Remove Utilities	9	Ea	800.00	7,200
Grade and Grass Site	9	Ea	500.00	4,500
Contingencies (20%)		LS		5,000
Total for Demolition and Site Reclamation				$30,200
Salvageable Items	9	Ea	(5,000.00)	(45,000)
Total Cost for Flood Plain Evacuation				$392,700

TABLE 2-E-14 (Continued)

Detailed Cost Estimate for Plan 27
(October 1985 Price Levels)

Item	Quantity	Unit	Unit Cost	Total Cost
MITIGATION COMPONENT				
Habitat Mitigation				
Land for Mitigation	3.7	Ac	$18,680.00	$69,100
Tree Plantings		LS		12,000
Contingencies (20%)		LS		16,200
Total Cost for Habitat Mitigation				97,300
Mitigation of Induced Flood Damages				
Raising Structures in Place				
Elevating the Structure	21	Ea	$2,100.00	$44,100
Foundation Work	21	Ea	2,000.00	42,000
Landscaping	21	Ea	1,000.00	21,000
Temporary Housing	21	Ea	500.00	10,500
Subtotal for Raising Structures in Place				117,600
Sealing One Structure				
Concrete	133.0	CY	200.00	26,600
Excavation	800	CY	5.50	4,400
Earth Fill	800	CY	6.50	5,200
Interior Drainage		LS		600
Sewer Modifications		LS		500
Landscaping		LS		1,500
Subtotal for Sealing One Structure				38,800
Contingencies (25%)				39,100
Total Construction Cost				195,500
Engineering and Design (10%)				19,500
Supervision and Administration (8%)				15,600
Total Cost for Mitigation of Induced Flood Damages				230,600
TOTAL COST FOR STRUCTURAL COMPONENT				$5,898,100
TOTAL COST FOR NONSTRUCTURAL COMPONENT				$392,700
TOTAL COST FOR MITIGATION COMPONENT				$327,900
TOTAL PROJECT FIRST COST				$6,619,000

Plan 28. Plan 28 also consists of channel enlargement with the same bottom width and side slopes as Plan 24B. The limits of work extend from Broad Street to Fortieth Avenue. However, for this plan no work would be performed between Kamper Park and U.S. Highway 49 upstream. The nine residences on Brooklane Street and South 17th Avenue would also be evacuated with this plan. The Plan 28 cost estimate was developed using October 1985 price levels.

TABLE 2-E-15
Detailed Cost Estimate for Plan 28
(October 1985 Price Levels)

Item	Quantity	Unit	Unit Cost	Total Cost
STRUCTURAL COMPONENT				
Project Construction				
Channel Enlargement				
Clearing and Grubbing	24.0	Ac	$1,400.00	$33,600
Disposal Area Clearing	3.6	Ac	1,500.00	5,400
Channel Excavation	139,800	CY	5.58	780,100
Riprap	12,060	CY	50.00	603,000
Bedding Material	3,990	CY	40.00	159,600
Filter Cloth	23,000	SY	3.00	69,000
Seeding and Mulching	24.0	Ac	2,300.00	55,200
Drainage Structures (6)		LS		127,300
Contingencies (20%)		LS		366,600
Total Construction Cost				2,199,800
Engineering and Design (8%)				176,000
Supervision and Administration (6%)				132,000
Total for Channel Enlargement				2,507,800
Total Cost for Project Construction				$2,507,800
Lands, Damages, and Relocations				
Lands and Damages				
Land for Right-of-Way	46.6	Ac	14,037.00	654,100
Severance Damages		LS		393,400
Structures to be Removed		LS		348,500
Land for Disposal Areas	7.2	Ac	2,000.00	14,400
Contingencies (20%)		LS		282,100
Administrative Costs	130	Ea	4,000.00	520,000
Total for Lands and Damages				2,212,500
Relocations				
Bridge Modifications (2)		LS		216,800
Electric Lines		LS		0
Pipelines (16)		LS		58,400
Contingencies (20%)		LS		55,000
Total for Relocations				330,200
Total Cost for Lands, Damages, and Relocations				$2,542,700

TABLE 2-E-15 (Continued)
Detailed Cost Estimate for Plan 28
(October 1985 Price Levels)

Item	Quantity	Unit	Unit Cost	Total Cost
NONSTRUCTURAL COMPONENT				
Flood Plain Evacuation				
Property Acquisition				
Value of Land and Structures	9	Ea	Varies	$309,600
Contingencies (20%)		LS		61,900
Administrative Costs	9	Ea	4,000.00	36,000
Total for Property Acquisition				$407,500
Demolition and Site Reclamation				
Remove Structures	9	Ea	1,500.00	13,500
Remove Utilities	9	Ea	800.00	7,200
Grade and Grass Site	9	Ea	500.00	4,500
Contingencies (20%)		LS		5,000
Total for Demolition and Site Reclamation				$30,200
Salvageable Items	9	Ea	(5,000.00)	(45,000)
Total Cost for Flood Plain Evacuation				$392,700

TABLE 2-E-15 (Continued)
Detailed Cost Estimate for Plan 28
(October 1985 Price Levels)

Item	Quantity	Unit	Unit Cost	Total Cost
MITIGATION COMPONENT				
Habitat Mitigation				
Land for Mitigation	3.1	Ac	$14,037.00	$43,500
Tree Plantings		LS		12,000
Contingencies (20%)		LS		11,100
Total Cost for Habitat Mitigation				66,600
Mitigation of Induced Flood Damages				
Raising Structures in Place				
Elevating the Structure	21	Ea	$2,100.00	$44,100
Foundation Work	21	Ea	2,000.00	42,000
Landscaping	21	Ea	1,000.00	21,000
Temporary Housing	21	Ea	500.00	10,500
Subtotal for Raising Structures in Place				117,600
Sealing One Structure				
Concrete	133.0	CY	200.00	26,600
Excavation	800	CY	5.50	4,400
Earth Fill	800	CY	6.50	5,200
Interior Drainage		LS		600
Sewer Modifications		LS		500
Landscaping		LS		1,500
Subtotal for Sealing One Structure				38,800
Contingencies (25%)				39,100
Total Construction Cost				195,500
Engineering and Design (10%)				19,500
Supervision and Administration (8%)				15,600
Total Cost for Mitigation of Induced Flood Damages				230,600
TOTAL COST FOR STRUCTURAL COMPONENT				$5,050,500
TOTAL COST FOR NONSTRUCTURAL COMPONENT				$392,700
TOTAL COST FOR MITIGATION COMPONENT				$297,200
TOTAL PROJECT FIRST COST				$5,740,400

APPENDIX 3

PLAN FORMULATION

APPENDIX 3

PLAN FORMULATION

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LIST OF TABLES

FORMULATION OF PLANS

INTRODUCTION

This appendix contains information regarding the process and findings related to formulating the flood damage reduction plan for the Gordons Creek flood plain in Hattiesburg, Mississippi. Although flood control was the primary objective of the study process, other objectives related to the land and water resources of the study area were also addressed. Plan formulation was conducted in accordance with planning guidance contained in ER 1105-2-30, General Planning Principles.

NATIONAL OBJECTIVES

The planning process used by the Corps of Engineers to develop, control, maintain, and conserve the water resources of the nation to best serve the public interest is governed by Principles and Guidelines for Water and Related Land Resources Implementation Studies as approved by the Executive Branch of the Federal Government. These Principles and Guidelines (P&G) state that the Federal objective of water and related land resources project planning is to contribute to national economic development (NED) consistent with protecting the national environment. The P&G requires that Federal water resources planning be responsive to State and Local concerns and that project plans be formulated to alleviate problems and take advantage of opportunities in the study area. NED is to be achieved by increasing the value of the United States output of goods and services and improving national economic efficiency.

Application of the P&G in formulating plans for Upper Gordons Creek was accomplished in an objective and professional analysis of the water resource problems and consideration of alternative measures judged to be practical solutions to problem solving. An evaluation was made of the adequacy of

various water resources management measures as prescribed by guidelines to insure that the proposed solutions are in the best public interest. These guidelines are briefly described as follows:

a. A full range of alternative measures to solve a problem, including positive and negative features, are considered from inception of the study;

b. The "with" and "without" conditions of each alternative are determined;

c. The flexibility of each alternative to meet changing national priorities and values is determined insofar as is possible;

d. The cumulative effects, both adverse and beneficial, of each alternative are continuously analyzed as a guide to decision making;

e. Public acceptance of each alternative plan was evaluated through public involvement and contacts with local and regional officials who are aware of public sentiments in the area; and,

f. Feasible plans are in agreement with long-range development goals of local, regional, State, and Federal objectives.

STUDY OBJECTIVES

The detailed objectives selected to guide the planning process during plan formulation for Upper Gordons Creek are listed below:

a. Reduce flood damages;

b. Minimize induced flood damages on the existing project on Gordons Creek;

c. Preserve and enhance community cohesion;

d. Maintain and enhance the integrity of the local economy;

e. Maintain and increase the quantity and/or quality of fish and wildlife habitat;

f. Maintain or improve water quality;

g. Contribute to outdoor recreation opportunities consistent with local needs and financial limitations;

h. Minimize adverse effects on cultural resources;

i. Reduce health hazards due to flooding;

j. Minimize anxieties and concerns over flood threats; and,

k. Minimize disruptions to the flow of automobile and rail traffic.

PLANNING CONSTRAINTS

The flood damage reduction plans were formulated and evaluated under technical criteria for engineering, economic and environmental constraints as follows:

a. All plans must have net national economic development benefits unless the deficiency is the result of benefits foregone or additional costs incurred to contribute to protection of environmental quality;

b. Protective works must be capable of being constructed and must be designed for the project life or be replaced with like structures;

c. Each element of an alternative plan must provide benefits at least equal to its cost;

d. The benefits and costs must be based on comparable economic terms;

e. Annual benefits and costs are based on a 50-year project life and the current interest rate prescribed by Law for Federal projects;

f. Nonstructural solutions should be economically feasible, implementable, and acceptable to local interests and to the individuals impacted by that solution; and,

g. The recommended plan must be compatible with the comprehensive development plan of the City of Hattiesburg.

POSSIBLE SOLUTIONS

In the course of this study, various alternatives for flood protection have been considered for solving the flooding problems along Upper Gordons Creek. These alternatives are divided into the two broad categories of nonstructural and structural measures. Nonstructural measures include zoning, subdivision regulations, building codes, flood proofing of both individual buildings and single land tracts, flood forecasting, and evacuation of flood plain areas. Structural measures include reservoirs, stream diversions, clearing and snagging, channel modifications, levees, and flood walls. Definitions of the measures are summarized in the following paragraphs.

NONSTRUCTURAL MEASURES

Nonstructural measures do not attempt to reduce or eliminate flood water levels. Instead, they are oriented toward lessening the damaging effects of floods by regulating usage of the flood plain.

Zoning. Zoning is a legal measure that state, county, or local government agencies can implement and enforce to effectively reduce the flood damage potential of an area in accordance with a planned program of development and land use. Zoning ordinances could designate the channel and those portions of the adjoining flood plain required for passage of floodwater in accordance with the degree of protection desired. Other areas of the flood plain where water is ponded could be developed, provided that adequate measures were taken to reduce the potential damage consistent with the risk involved and also provided that no additional flooding occurs elsewhere as a result of development. Limiting elevations could be established, below which development would not be permitted. Zoning measures insure the safekeeping of property for the health, welfare, and safety of the general public. The City of Hattiesburg is currently enrolled in the Flood Insurance Program which requires the implementation of these measures in accordance with the National Flood Insurance Act of 1968, as amended.

Subdivision Regulations. Subdivision regulations can be used by local governments to specify the manner in which land may be divided. Regulations could be adopted to state requirements for street widths and minimum elevations, drainage structures, minimum building elevations, and restrictions on location to provide for adequate passage of flood flows and minimize flood damages.

Building Codes. Local government agencies can adopt building code regulations to assist in reducing future flood damages. These codes would set forth standards for the construction of buildings and can prescribe the type of basement and first floor elevations, specify strength of materials that would withstand water pressure of high velocity flows and prohibit any equipment or material in the potential flood plain that would be hazardous to life.

Flood Proofing. Flood proofing is employed primarily for the reduction or elimination of flood damages to existing structures. Flood proofing includes but is not limited to:

a. Raising existing buildings;
b. Providing individual dikes around existing structures;
c. Providing permanent or temporary water-tight covers for all openings;
d. Protecting roads and utilities; and,
e. Anchoring floatable structures and facilities.

Flood Forecasting. Reliable and timely forecasts of floods can be a valuable asset in reducing flood losses. However, in a small size drainage basin with a relatively fast rate of rainfall runoff, floods are generally of a flash type which would preclude early determination of a flood event along the creek.

Evacuation. Permanent evacuation of flood plain areas can be used to reduce the flood damage and restore the natural function of the flood plain. Evacuation measures could involve removal of all buildings and other developments from the flood plain. Lands acquired in this manner could be used for parks or other purposes that would not interfere with flood flows or result in significant damage from floods. Also, some flood plain land could be left as natural scenic areas.

Other Measures. Other preventive measures could be provided in the flood plain such as warning signs, tax adjustments, restrictions on building financing, urban redevelopment, and other measures whereby local Governments provide incentives for flood prone residents to take measures on their own. These measures could effectively reduce or eliminate future damage in the flood plain.

STRUCTURAL MEASURES

Structural measures differ from nonstructural measures in that they are intended to keep flood waters away from damage susceptible property, rather than to keep damageable property away from the floodwater. Structural measures ordinarily involve the construction of large or extensive flood control facilities.

Reservoirs. In some cases it is possible to build a dam in an upper reach of the stream to reduce flooding downstream. The dam would catch the water that falls in the upper part of the basin and hold it until the peak has passed, then release the upstream water at a controlled rate. By detaining the water behind the dam, the rain that falls below the dam can enter the creek and flow downstream at a reduced flood stage. The effectiveness of this type of flood control measure depends primarily on the availability of undeveloped lands and the amount of rainfall controlled.

Diversions. Sometimes the general character of the basin will allow diversion of flood flows into another basin at some point upstream of the major damage area. This meaure must include steps to prevent conditions from becoming worse in the basin that receives the increased flood waters.

Clearing and Snagging. This measure involves the clearing of the stream banks and the snagging of logs and debris from the channel. Dense underbrush, log jams, trash and debris can severely restrict the amount of water a stream can carry and therefore, cause it to flow out of its bank in effort to pass water downstream. Removal of these obstructions can result in a reduction in flood stages.

Channel Modification. This type of measure improves the hydraulic carrying capacity of a stream's channel to lower flood stage levels. This measure can include any changes in the channel configuration from minor bank shaping to a complete channel relocation. Usually, it implies the widening and deepening of an existing channel and straightening of bends to provide a larger cross-sectional area and steeper bottom slope.

Levees. A levee is an earth dike or embankment erected as a barrier to prevent flood waters from entering the area behind the levee, and is usually built parallel to a stream to protect development along the stream. The height of the levee depends on the expected flood height that is being protected against. Because a levee cuts off natural drainage patterns into the stream, provisions must be made to accommodate interior runoff occurring behind the levee.

Flood Walls. A reinforced concrete wall may be used in lieu of a levee in areas where available lands preclude the construction of a levee. Alignment, height, and interior drainage would be designed with the same criteria as a levee. Flood walls are generally more expensive to construct than a levee.

INITIAL STAGE PLAN DEVELOPMENT

During the early stages of this study, various alternative flood protection measures were considered for solving the flooding problems along Gordons Creek. A no action plan, reflecting the continuation of current trends of development and damages, was considered and used as a base for comparison of the impacts of the other alternatives evaluated.

A number of measures which are sometimes used in flood control proved to be impractical due to the characteristics of the study area. Upstream reservoirs were eliminated from study because urban development is so extensive that space is not available for flood water storage. Because of the urban characteristics of the stream, clearing and snagging would have little impact on flood levels and was therefore eliminated from consideration. A system of levees or concrete floodwalls along the banks of the creek was also found to be impractical due to urban improvements that extend to the banks of the creek and numerous road crossings which would require closure structures during flood periods.

Other measures which are effective for flood control are currently being implemented in the study area and cannot further reduce future flood losses. The City of Hattiesburg is in the regular phase of the flood insurance program. Flood plain zoning, subdivision regulations, and restrictions on building codes are established and administered by the city.

Based on the characteristics of the study area and concerns expressed by the citizens of the area, four general measures were selected as the most promising actions that could be taken to reduce the flood damages along the creek. They are: Measure 1 -diversion of flood waters, Measure 2 - channel enlargements, Measure 3 - flood plain evacuation, and Measure 4 - increased flood warning capabilities.

MEASURE 1 - DIVERSION PLANS

Diversion of flood waters into the Burketts Creek drainage basin was suggested as a solution for flooding on Gordons Creek at the initial stage public meeting. Subsequent coordination with local interests has indicated a strong interest in this measure. An area near the intersection of Highway 49 and U. S. Highway 11 was found to be the best location for a potential diversion. Four options for the alignment of a diversion into the head waters of Burketts Creek were identified and designated as Plans 11 through 14. Plans 13 and 14 were selected from the topography of the area as the least expensive and examined in detail.

The plans were designed to the extent that major costs could be identified and compared to the reduction in damages that would be experienced on Gordons Creek. Both plans were designed to divert a maximum discharge of 2,000 cfs from Gordons Creek southward along U. S. Highway 49 at approximately river mile 5.

Plan 13. Plan 13 would divert flood waters to a tributary of Burketts Creek named Burney Creek. A reinforced concrete box culvert, consisting of two 10 foot by 10 foot barrels, would extend from Gordons Creek south to Burney Creek and then turn east to cross Highway 49. The Culvert would be approximately 2200 feet long requiring, in one reach, a cut of over 30 feet. On the east side of Highway 49, the culvert invert would be approximately eight feet below the existing invert of Burney Creek. From this point to approximately 3,300 feet downstream, a concrete lined channel would be constructed.

The costs of the easily identifiable, major components were estimated to be $4,636,400. This project cost is equivalent to annual costs of $384,400 based on an interest rate of 8-1/8 percent and a 50-year project life. The

reduction in damages on Gordons Creek was found to be $316,700. Therefore the costs in an incomplete cost estimate exceeded the benefits that would accrue to Gordons Creek residents and the plan cannot be justified. The analysis did not go far enough to consider the impacts of increased flooding in the Burketts Creek basin.

Plan 14. Plan 14 has a culvert with geometry identical to the culvert for Plan 13. However, in this plan the culvert is approximately twice as long. The partial costs of this plan exceed the costs of Plan 13 and the plan cannot be justified.

Because of the results of the analyses of Plans 13 and 14, Plans 11 and 12 were not evaluated.

MEASURE 2 - CHANNEL ENLARGEMENT PLANS

The existing project on Gordons Creek consists of clearing and snagging for 1.2 miles upstream from the mouth of the creek and then an excavated channel with a 40 foot bottom width for an additional 1.3 miles upstream to Broad Street. The excavated channel reach has side slopes of 1 vertical on 2 horizontal in most locations.

Six options for channel enlargement plans, designated as Plans 21 through 26, were investigated for the upper portion of Gordons Creek. For all the plans, the alignment and bottom profile of the existing creek would be maintained. An excavated channel with grassed side slopes was found to be satisfactory and much less expensive than a concrete or rock lined channel. However, side slopes of 1 vertical on 3 horizontal are necessary due to soil types and the depth of the existing channel. Therefore, all the plans have vegetated banks on a slope of 1 vertical on 3 horizontal. From the hydraulic and economic studies, we found that an upstream channel excavation plan cannot be implemented without causing some adverse impacts within the upper limits of the existing project. In order to minimize impacts on the existing project, excavated channels larger than the existing channel downstream of Broad Street were not considered in the study.

Plan 21. Plan 21 consist of a 40-foot bottom width channel extending 1.1 miles from the end of the existing project at Broad Street to the Hardy Street crossing of the creek. At Hardy Street the channel would be joined to an existing concrete lined channel that runs through Kamper Park. Riprap would be provided at 4 bridge crossings and at 4 locations in curves on the channel banks. Removal of 3 structures would be required to construct the channel. The first costs of Plan 21 are estimated to be $1,521,600.

Plan 22. Plan 22 includes a channel with the same cross section and alignment as Plan 21 between Broad Street and Kamper Park. An additional increment of work is added upstream of Kamper Park. A 40-foot bottom width channel extends from the existing concrete channel in the park upstream to U. S. Highway 49. The length of the additional channel is 1.4 miles and the total length of the work is 2.5 miles. Riprap would be provided at 8 bridge crossings and at 14 locations in curves on the channel banks. Removal of 4 structures would be required to construct the channel. The first costs of Plan 22 are estimated to be $3,554,400.

Plan 23. Plan 23 is like Plan 22 except a 40-foot bottom width channel extends from the end of Plan 22 at U. S. Highway 49 to South 28th Avenue. The additional channel is 1.1 miles long and the total length of the work is 3.6 miles. Riprap would be provided at 11 bridge crossings and at 17 locations in curves on the channel banks. Removal of 8 structures would be required to construct the channel. The first costs of Plan 23 are estimated to be $4,985,900.

Plan 24. Plan 24 has a channel with the same dimensions and limits as Plan 23 downstream of South 28th Avenue. An increment of work consisting of a 30-foot bottom width channel is added between South 28th Avenue and the intersection of South 40th Avenue and Lincoln Road. The additional channel is 1.1 miles long and the total length of the work is 4.7 miles. Riprap would be provided at 19 bridge crossings and at 21 locations in curves on the channel banks. Removal of 8 structures would be required to construct the channel. The first costs of Plan 24 are estimated to be $7,209,100.

Plan 25. Plan 25 combines Plan 24 with a 30-foot bottom width channel on the tributary that enters Gordons Creek at Kamper Park. The additional work begins at the end of the concrete channel in Kamper Park and extends upstream 0.6 miles to U.S. Highway 49. The total length of the work for this plan is 5.3 miles. Riprap would be provided at 22 bridge crossings and at 22 locations in curves on the channel banks. Removal of 24 structures would be required to construct the channel. The first costs of Plan 25 are estimated to be $9,026,200.

Plan 26. Plan 26 contains all the elements of Plan 25 with a 20-foot bottom width channel extending from U.S. Highway 49 to South 34th Avenue. The additional channel is 1.1 miles and the total length of the work is 6.4 miles. Riprap would be provided at 26 bridge crossings and at 24 locations in curves on the channel banks. Removal of 26 structures would be required to construct the channel. The first costs of Plan 26 are estimated to be $10,329,900.

Plans 21 through 26 are formulated to determine the optimum design for excavated channel length. An estimate of interest during construction was added to the first costs for each plan and annual costs were computed using a 50-year project life. Operation and maintenance costs were added to determine the total annual costs. The results of the cost and benefit analysis are presented on Table 3-1. The annual benefits and costs are based on an interest rate of 8-1/8 percent and November 1982 price levels. The table shows project feasibility for: (1) Upper Gordons creek considered separately from the existing project, (2) the impacts of each plan on the existing project, and (3) Upper Gordons creek combined with the existing project.

TABLE 3-1
Upper Gordons Creek Initial Stage Plan Formulation Results
Channel Enlargement Plans
(November 1982 Prices and Development)

Plan	Existing Damages $1,000	Annual Benefits $1,000	Annual Costs $1,000	Net Benefits $1,000	B/C	Remaining Damages $1,000	Damages Removed %
UPPER GORDONS CREEK							
21	1,341.99	238.59	146.14	92.45	1.6	1,103.40	17.8%
22	1,341.99	469.37	327.63	141.74	1.4	872.62	35.0%
23	1,341.99	664.74	455.92	208.82	1.5	677.25	49.5%
24	1,341.99	923.72	654.80	268.92	1.4	418.27	68.8%
25	1,341.99	972.50	817.40	155.10	1.19	369.49	72.5%
26	1,341.99	989.11	934.20	54.91	1.06	352.88	73.7%
IMPACT ON THE EXISTING PROJECT							
21	70.07	(15.39)				85.46	
22	70.07	(29.69)				99.76	
23	70.07	(29.54)				99.61	
24	70.07	(30.78)				100.85	
25	70.07	(35.96)				106.03	
26	70.07	(36.37)				106.44	
UPPER GORDONS CREEK COMBINED WITH THE EXISTING PROJECT							
21	1,412.06	223.20	146.14	77.06	1.5	1,188.86	15.8%
22	1,412.06	439.68	327.63	112.05	1.3	972.38	31.1%
23	1,412.06	635.20	455.92	179.28	1.4	776.86	45.0%
24	1,412.06	892.94	654.80	238.14	1.4	519.12	63.2%
25	1,412.06	936.54	817.40	119.14	1.15	475.52	66.3%
26	1,412.06	952.74	934.20	18.54	1.02	459.32	67.5%

For Plans 22 through 26, each plan is defined as an upstream segment of work combined with all previously analyzed downstream work. An analysis was made of the incremental justification of each added segment of work. Table 3-2 shows a summary of the benefit and cost data for the upstream segments as compared to Plan 21. The induced damages on the existing project are subtracted from the benefits presented.

TABLE 3-2
Incremental Justification

Item	Annual Benefits	Annual Costs	B/C
Plan 21	223.20	146.14	1.5
Plan 22 Increment	216.48	181.48	1.2
Plan 23 Increment	195.52	128.30	1.5
Plan 24 Increment	257.74	198.88	1.3
Plan 25 Increment	43.60	162.60	0.27
Plan 26 Increment	16.20	116.80	0.14

MEASURE 3 - EVACUATION PLANS

An analysis was made to identify the structures in the flood plain that receive enough damages from flooding to justify their removal. Two nonstructural plans were developed. The first plan, Plan 31, involved evacuation of all structures affected by the 10-year frequency flood. The plan consisted of the evacuation of 162 residences and 10 commercial structures. Costs for this plan exceeded the benefits and the plan was not feasible. Therefore, Plan 32 was formulated to remove the maximum number of structures that are feasible in flood plain areas along the creek. Only eighteen structures within the 10-year flood plain were feasible for evacuation. Evacuation of the structures would remove only 14.1 percent of the flood damages in the basin. Therefore, the impacts of this measure were too small for consideration as a solution to the flooding problems along Gordons Creek. The results of the cost and benefit analysis are presented in Table 3-3. The annual benefits and costs are based on an interest rate of 8-1/8 percent and November 1982 price levels.

TABLE 3-3
Upper Gordons Creek Initial Stage Plan Formulation Results
Evacuation Plans
(November 1982 Prices and Development)

Plan	Existing Damages $1,000	Annual Benefits $1,000	Annual Costs $1,000	Net Benefits $1,000	B/C	Remaining Damages $1,000	Damages Removed %
UPPER GORDONS CREEK							
31	1,341.99	682.15	1,175.48	-493.33	0.6	659.84	50.8%
32	1,341.99	188.79	126.43	62.35	1.5	1,153.20	14.1%
IMPACT ON THE EXISTING PROJECT							
31	70.07	0.00				70.07	
32	70.07	0.00				70.07	
UPPER GORDONS CREEK COMBINED WITH THE EXISTING PROJECT							
31	1,412.06	682.15	1,175.48	-493.33	0.6	729.91	48.3%
32	1,412.06	188.79	126.43	62.35	1.5	1,223.27	13.4%

MEASURE 4 - INCREASED FLOOD WARNING CAPABILITIES

The practicality of providing additional flood warning for residents along Gordons Creek was considered during the study. The creek has a drainage area of 10.01 square miles at its mouth and 1.14 square miles at the Interstate 59 crossing, mile 7.9, in the headwaters of the creek basin. The upstream end of various alternative channel plans is only 7.4 miles above the mouth of the creek. About 89 percent of the basin is filled with urban development. Due to the small size of the basin and relatively fast rate of rainfall runoff, floods in the basin are generally flashy and prevent the benefits associated with early warning of impending floods. Therefore, flood warning systems were eliminated from further consideration in the study.

ADDITIONAL CHANNEL ENLARGEMENT PLANS

From the analysis of various individual measures, channel enlargement was found to be the only practical measure for reducing flood damages along Gordons Creek. From the analysis of channel enlargement options, Plan 24 was found to be the plan that provided the greatest amount of net benefits. Plan 24 consists of channel enlargement on the main creek from the upper end of the existing project at Broad Street to the intersection of Lincoln Road and South 40th Avenue. The incremental analysis shows that the added segments of work in Plans 25 and 26 are not justified. These segments consist of work on the tributary. Channel enlargement was not incrementally feasible on the tributary primarily because of the costs of removing structures from the creek banks. An analysis was performed to determine if sheet pile head walls could be used to avoid the structures. However, the cost of work on the tributary was not reduced with the sheet pile head walls.

Modifications of Plan 24 were investigated to find the optimum channel width, reduce and mitigate the flood damage impacts on the existing project, and minimize or mitigate environmental impacts of the work.

Two alternatives, designated as Plans 24A and 24B, were investigated to evaluate the impacts of varying channel width as compared to Plan 24.

Plan 24A. Plan 24A consists of a 40-foot bottom width channel extending from Broad Street to Kamper Park as in Plan 24. The bottom width of the segment of work between Kamper Park and South 28th Avenue is reduced from 40 feet to 30 feet. The channel bottom width is also 30 feet between South 28th Avenue and the intersection of South 40th Avenue and Lincoln Road as in Plan 24. Riprap would be provided at 19 bridge crossings and at 21 locations in curves on the channel banks. Removal of 8 structures would be required to construct the channel. The first costs of Plan 24A are estimated to be $6,605,500.

Plan 24B. Plan 24B includes a channel with the same cross section and limits of work as Plan 24A between Broad Street and South 28th Avenue. The segment of work between South 28th Avenue and the intersection of South 40th Avenue and Lincoln Road is reduced from a 30 foot bottom width to a 20 foot bottom width. Therefore, in relation to Plan 24, this plan consists of a 10 foot reduction in bottom width for all work upstream of Kamper Park. Riprap would be provided at 19 bridge crossings and at 21 locations in curves on the channel banks. Removal of 8 structures would be required to construct the channel. The first costs of Plan 24B are estimated to be $6,065,400.

An estimate of interest during construction was added to the first costs for both plans 24A and 24B and annual costs were computed using a 50-year project life. Operation and maintenance costs were added to determine the total annual costs. The results of the cost and benefit analysis are compared to Plan 24 data on Table 3-4. The annual benefits and costs are based on an interest rate of 8-1/8 percent and November 1982 price levels. The table shows project feasibility for: (1) Upper Gordons creek considered separately from the existing project, (2) the impacts of each plan on the existing project, and (3) Upper Gordons creek combined with the existing project.

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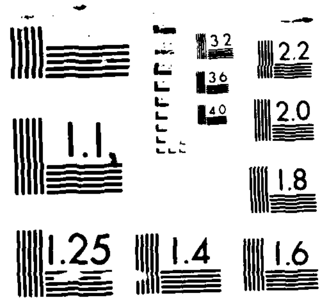

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TABLE 3-4
Upper Gordons Creek Initial Stage Plan Formulation Results
Additional Channel Enlargement Plans
(November 1982 Prices and Development)

Plan	Existing Damages $1,000	Annual Benefits $1,000	Annual Costs $1,000	Net Benefits $1,000	B/C	Remaining Damages $1,000	Damages Removed %
UPPER GORDONS CREEK							
24	1,341.99	923.72	654.80	268.92	1.4	418.27	68.8%
24A	1,341.99	873.35	601.28	272.07	1.5	468.64	65.1%
24B	1,341.99	859.16	553.07	306.09	1.6	482.83	64.0%
IMPACT ON THE EXISTING PROJECT							
24	70.07	(30.78)				100.85	
24A	70.07	(26.52)				96.59	
24B	70.07	(26.55)				96.62	
UPPER GORDONS CREEK COMBINED WITH THE EXISTING PROJECT							
24	1,412.06	892.94	654.80	238.14	1.4	519.12	63.2%
24A	1,412.06	846.83	601.28	245.55	1.4	565.23	60.0%
24B	1,412.06	832.61	553.07	279.54	1.5	579.45	59.0%

From the analysis of varying channel widths, a 10 foot reduction in channel bottom width for all work upstream of Kamper Park was found to produce an increase in net benefits and a slight decrease in impacts on the existing project. The reduction would also produce less clearing in the channel overbank and thereby reduce the environmental impacts of the work. Further reductions in channel bottom width were judged to be not practical because the bottom width of the constructed channel is nearly equal to the bottom width of the existing channel in many areas.

SUMMARY OF INITIAL STAGE PLANNING

Channel enlargement has been found to be the only practical measure available to reduce flood damages along Upper Gordons Creek. From an investigation of various channel sizes, Plan 24B has been found to produce the highest net benefits. Therefore, at this stage Plan 24B was selected as the best plan to provide flood damage reduction for Upper Gordons Creek.

FINAL STAGE PLAN DEVELOPMENT

Studies continued to refine Plan 24B for detailed design. Refinements were made in project design to mitigate environmental impacts of the plan. These refinements included increased right-of-way and tree plantings at selected locations. A study was made and a plan was recommended to the local sponsor to mitigate the flood damage impacts on the existing project. Modifications were made in two bridges. A more detailed estimate was made of lands and damages costs. Interest rates and price levels were updated and the flood damage appraisal was refined. These adjustments were judged to have similar impacts on all alternatives and would not affect plan selection. The revised cost estimate for Plan 24B is $7,940,500.

A check was made of bridge modifications to reduce flood stages. Bridges on the main creek at U.S. Highway 49, U.S. Highway 11 (upstream of Highway 49), and U.S. Highway 11 (Broadway Drive downstream) were enlarged and an economic analysis was made of the change in damages. The work could not be justified.

Two variations of Plan 24B, designated as Plans 27 and 28, were investigated to evaluate the impacts of removing a portion of the work upstream of the concrete lined channel in Kamper Park. Flood plain evacuation was substituted to reduce damages in the omitted reaches of stream.

<u>Plan 27</u>. Plan 27 consists of channel enlargement with the same bottom widths and side slopes as Plan 24B. The limits of work extend from Broad Street to Fortieth Avenue in a similar manner as Plan 24B except no work would be performed in the portion of the stream between Kamper Park and Broadway Drive (U.S. Highway 11). Eight residences on Brooklane Street and one residence on South 17th Avenue were found to be feasible for evacuation and are included in the plan. The first costs of Plan 27 are estimated to be $6,619,000.

<u>Plan 28</u>. Plan 28 also consists of channel enlargement with the same bottom width and side slopes as Plan 24B. The limits of work extend from Broad Street to Fortieth Avenue. However, for this plan no work would be performed between Kamper Park and U.S. Highway 49 upstream. The nine residences on Brooklane Street and South 17th Avenue would also be evacuated with this plan. The first costs of Plan 28 are estimated to be $5,740,400.

Plan 24B was compared to the additional plans. Interest during construction, a 50-year project life, and operation and maintenance costs were included in the analysis. A summary of comparative data relating to the alternative plans is given in Table 3-5. Annual benefits and costs are based on an interest rate of 8-5/8 percent and October 1985 price levels.

TABLE 3-5
Upper Gordons Creek Final Stage Plan Formulation Results
(October 1985 Prices and Development)

PLAN	BENEFITS & COSTS 1/			B/C	DAMAGES 1/			DAMAGES 1/		
	Benefits	Costs	Net Ben		Existing	Remaining	Removed	Existing	Induced	Resulting
	PROPOSED PLAN SEPARATE FROM THE EXISTING PROJECT							EXISTING PROJECT		
24B	1,084.17	739.18	344.99	1.5	1,426.45	342.28	76.0%	72.65	-27.48	100.13
27	1,024.60	614.89	409.71	1.7	1,426.45	401.85	71.8%	72.65	-27.48	100.13
28	879.41	532.24	347.17	1.7	1,426.45	547.04	61.7%	72.65	-27.48	100.13
	PROPOSED PLAN COMBINED WITH THE EXISTING PROJECT 2/									
24B	1,142.41	760.88	381.53	1.5	1,499.10	356.69	76.2%			41.89
27	1,082.84	636.57	446.27	1.7	1,499.10	416.26	72.2%			41.89
28	937.65	553.94	383.71	1.7	1,499.10	561.45	62.5%			41.89

1/ Benefit, Cost, and Damage Values are shown in thousands of dollars.

2/ Includes mitigation of downstream damages so that the resulting damages would be less than the existing damages.

SUMMARY OF FINAL STAGE PLANNING

From the data in Table 3-5, it was determined that Plan 27 provided the highest net economic benefits. The plan removes 72 percent of the average annual flood damages in the basin and has less fish and wildlife losses than Plan 24B. Therefore, Plan 27 is defined as the NED Plan and refined for detailed design leading to a recommendation for implementation.

APPENDIX 4
ENVIRONMENT INVESTIGATIONS

APPENDIX 4
ENVIRONMENTAL INVESTIGATIONS

TABLE OF CONTENTS

GORDONS CREEK, MISSISSIPPI

ENVIRONMENTAL RESOURCES INVENTORY

Prepared by

U. S. Army Engineer District, Mobile, Alabama

January 1984

GORDONS CREEK, MISSISSIPPI
ENVIRONMENTAL RESOURCES INVENTORY

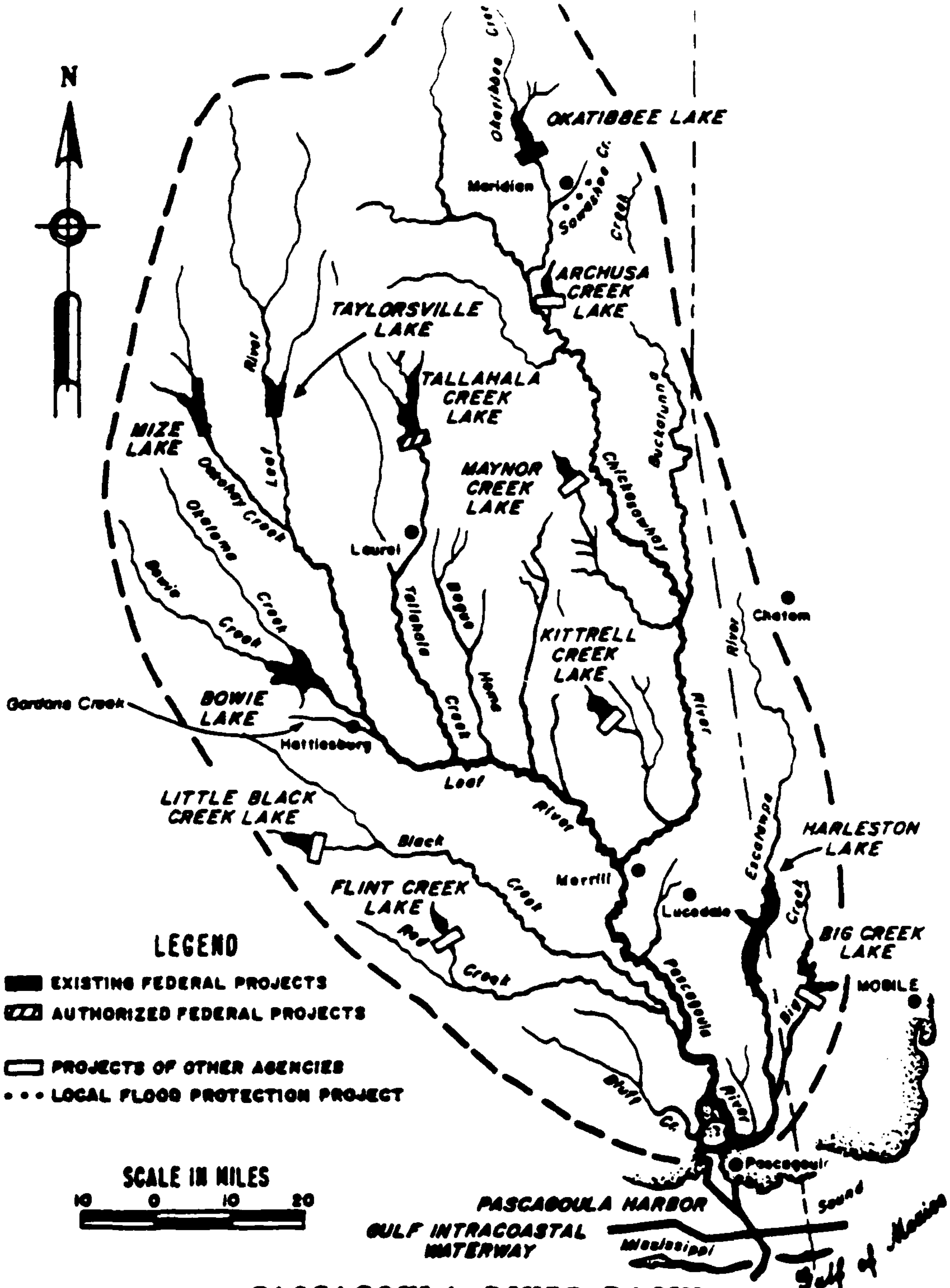
GENERAL

Gordons Creek is a highly urbanized tributary of the Leaf River entering the latter approximately 0.5 mile below the confluence of the Leaf and Bowie Rivers in Hattiesburg, Mississippi. The location of these streams, which are components of the Pascagoula River basin, is depicted on Figure 1.

Gordons Creek, which has a drainage area of 10 square miles, originates from a number of intermittent streams on either side of the Lamar-Forrest County line. From this area the stream flows generally northeast approximately 7.8 miles through the central portion of Hattiesburg before joining the Leaf River. The Gordons Creek drainage basin is shown on Figure 2.

Burketts Creek originates from a number of intermittent streams on either side of the Lamar-Forrest County line near the city of Richburg, Mississippi. From this area the stream flows northeast approximately paralleling Gordons Creek south of the city of Hattiesburg, Mississippi, before joining the Leaf River approximately 3 miles south of the mouth of Gordons Creek. Burketts Creek, which is not as highly urbanized as is Gordons Creek, also has a drainage area of approximately 10 square miles.

The Gordons Creek and Burketts Creek drainage basins lie within the Longleaf Pine Hills physiographic region of the East Gulf Coastal Plain Province. The hills of this region are composed of clay overlain with a veneer of sand and gravel. The underlying formations of Miocene Age consist of the Hattiesburg formation and the Catahoula sandstone. The topography of



PASCAGOULA RIVER BASIN
MISSISSIPPI AND ALABAMA

Figure 1

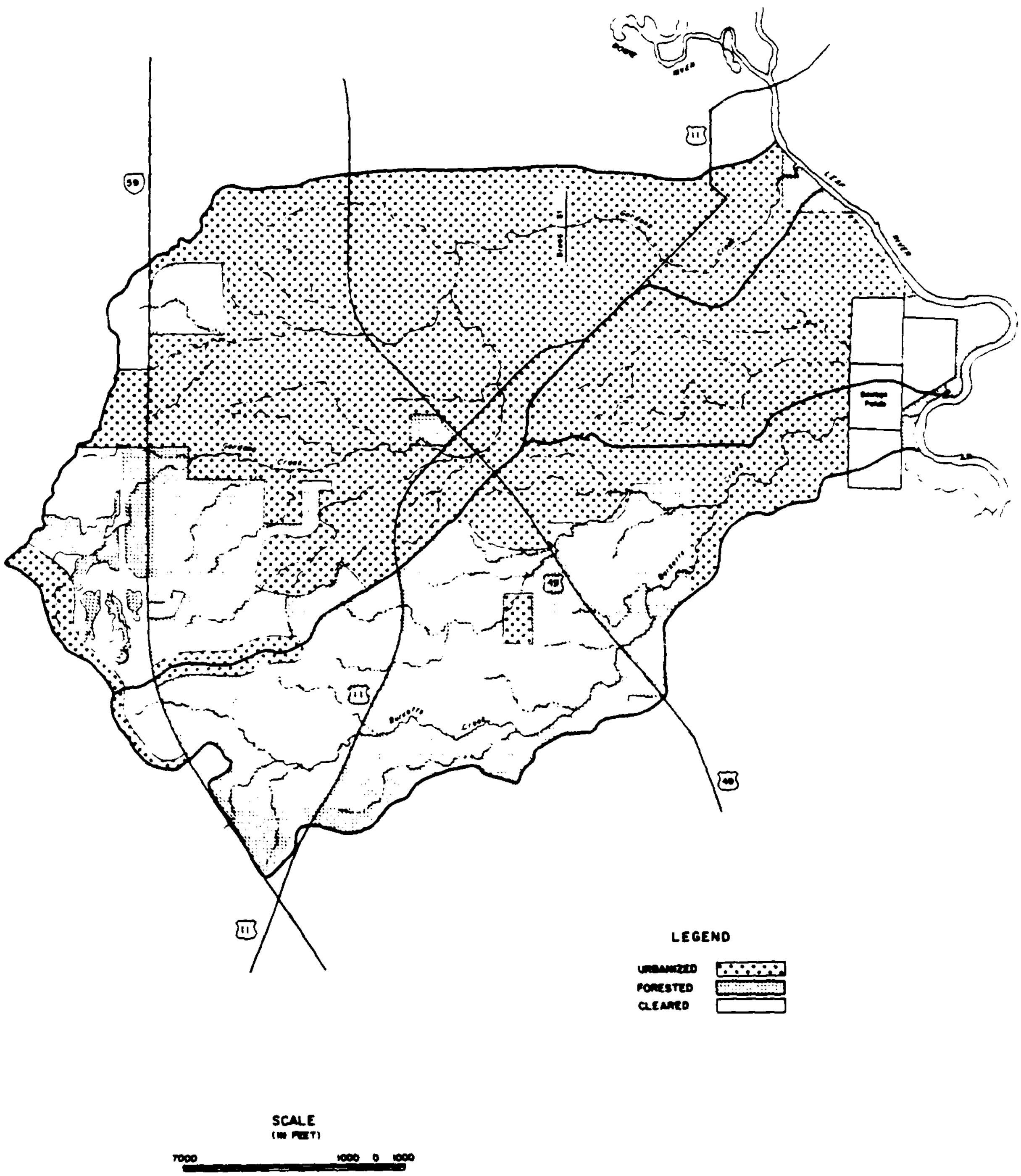


Figure 2

LAND USE MAP

GORDONS CREEK DRAINAGE BASIN

the basin slopes generally from elevation 250 at the divides to elevation 150 near the mouth.

EXISTING CORPS PROJECT

In 1947, 1957, and 1961 major floods occurred on Gordons Creek which caused substantial damage in Hattiesburg. As a result of these floods, the Corps of Engineers was requested to study flood control measures along the creek and in 1979 constructed a Section 205 project on the lower 2.35 miles of the stream. The project consisted of clearing and snagging of the stream from the mouth to Bay Street (1.11 miles), and providing an enlarged, unlined channel with a 40-foot bottom width from Bay Street to Broad Street (1.24 miles). Figure 3 shows the features of the existing project. The Pat Harrison Waterway District (PHWD), which is the local sponsor, is responsible for operation and maintenance activities of this existing project which include the following: periodic inspection of the project area; keeping the channel clear of debris; removing shrubs and trees from cleared areas; control of bank erosion; maintenance of riprap sections; and maintaining grassed areas. All indications are that the project is essentially being maintained in a satisfactory manner.

FLOODING PROBLEMS

Since the existing project was completed in 1979, upstream areas of Gordons Creek, particularly the uppermost 3 miles of the stream, have undergone extensive development. Areas along the middle reaches of the creek have been developed with large shopping complexes, motels, and businesses such as food stores, fast food restaurants, and car dealerships. The area adjacent to

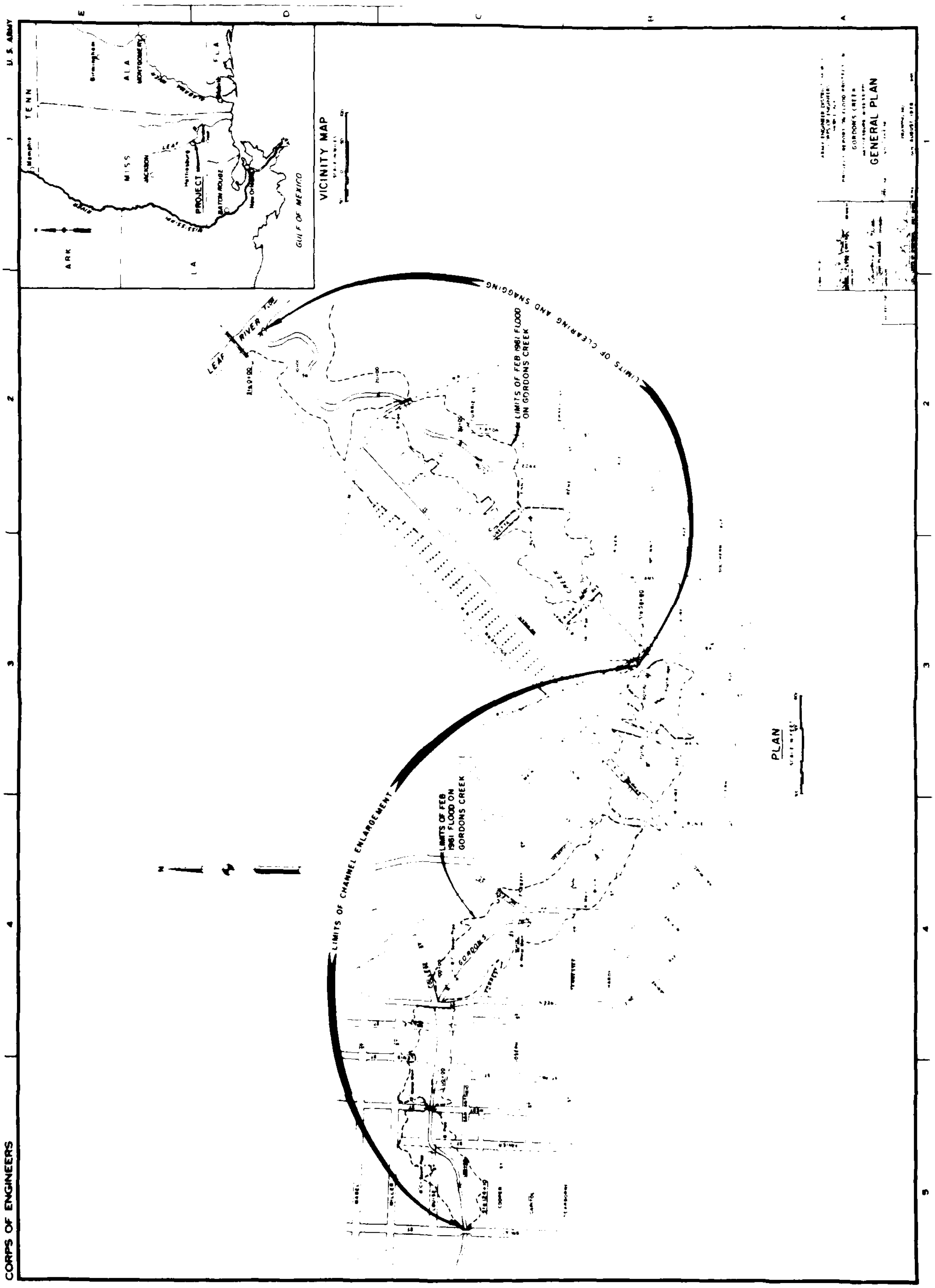

U. S. ARMY
CORPS OF ENGINEERS
VICINITY MAP
GULF OF MEXICO
PROJECT
BATON ROUGE
TENN
MISS
ALA
ARK
LA
FLA
LEAF RIVER
LIMITS OF CLEARING AND SNAGGING
LIMITS OF FEB 1981 FLOOD ON GORDONS CREEK
LIMITS OF CHANNEL ENLARGEMENT
LIMITS OF FEB 1981 FLOOD ON GORDONS CREEK
PLAN
GORDONS CREEK
GENERAL PLAN

Figure 3

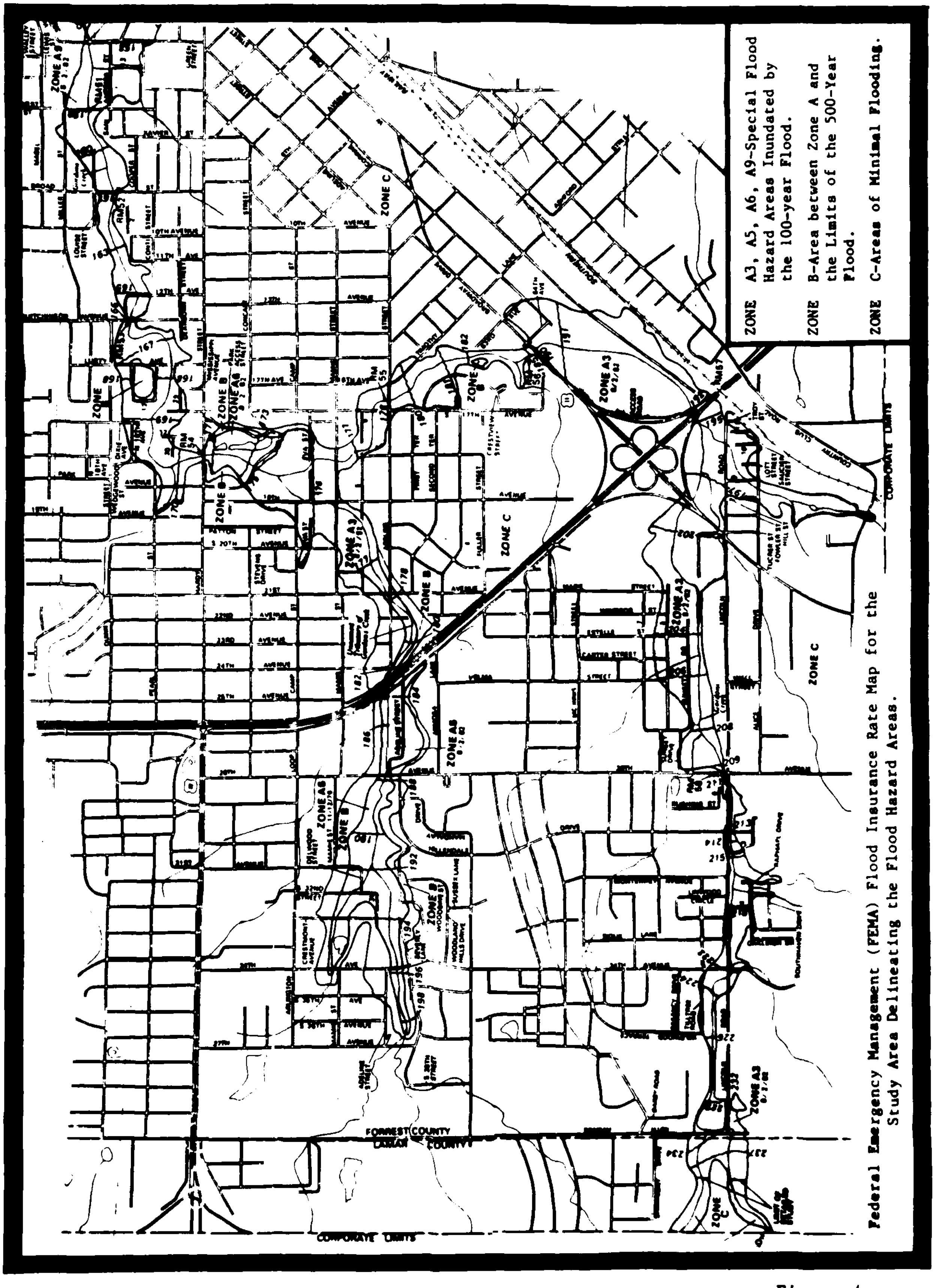
the upper reaches have primarily been developed in residential subdivisions, with homes valued from $70,000 to $120,000, as well as a number of small commercial establishments. These newly developed areas were inundated durin the flood of April 1980 and the recent April 1983 flood. During the 1983 storm, the 500-year flood stage was reached in downtown Hattiesburg. As a result of the flooding, the city of Hattiesburg requested the Corps to exami the upper reaches of Gordons Creek for possible additional flood control works.

The city of Hattiesburg participates in the flood insurance program which is administered by the Federal Emergency Management Agency (FEMA). Figure 4 shows the zones delineated by FEMA in the special flood hazard areas. This information is to be used by local agencies in developing flood plain management plans or as a basis for further studies. In addition, the information is the basis for the determination of insurance rates by FEMA.

CLIMATE

The climate of Hattiesburg is semi-tropical and humid, with an average temperature of 65.8°F based on 89 years of record. Monthly temperatures rang from average lows of 50.7°F in December to average highs of 81.4°F in July. Minima and maxima of -1°F and 106°F have been recorded. The normal frost-fre period of 8 months lasts from March to November.

Hattiesburg is in a region which ordinarily receives an abundant rainfall uniformly distributed through the year. Annual precipitation at Hattiesburg averages 59.29 inches, of which 26% occurs in winter, 29% in spring, 27% in



Federal Emergency Management (FEMA) Flood Insurance Rate Map for the Study Area Delineating the Flood Hazard Areas.

Figure 4

summer, and 18% in fall. March is the wettest month with an average rainfall of 6.96 inches; extremes range from 0.34 to 15.10 inches. October is the driest month with an average of 2.53 inches. Average monthly and annual rainfall amounts are listed in Table 1.

Table 1

Normal Monthly and Annual Precipitation
for Hattiesburg, Mississippi

MONTH	Inches
January	4.71
February	5.71
March	6.96
April	5.03
May	4.91
June	4.26
July	5.73
August	5.14
September	4.24
October	2.53
November	4.00
December	6.07
Annual	59.29 inches

Flood-producing storms over the study area may occur at any time. However, they are more numerous in winter and spring when the lack of vegetative cover and the high moisture content of the soils combine to result in higher rates of rainwater runoff. Major flood-producing storms that occur in winter and spring generally last from 2 to 4 days and are usually of the frontal type that cover large areas. Summer storms are normally of the thunderstorm type with high intensities over small areas. Since the beginning of the century, nine major floods occurred in the study area--in 1900, 1920, 1921, 1943, 1961, 1964, 1974, 1980, and 1983. These floods inundated the flood plain to depths ranging up to approximately 20 feet. Extreme maximum, minimum, and 24-hour maximum amounts of rainfall with the year of occurrence are listed in Table 2.

Table 2

Extreme Monthly Maximum, Minimum, and Maximum in 24 Hours Rainfall at Hattiesburg, Mississippi, Along With Year of Occurrence

Month	Maximum of Record (inches)	Maximum of Record (year)	Minimum of Record (inches)	Minimum of Record (year)	24-Hour Maximum of Record (inches)	24-Hour Maximum of Record (day/year)
January	12.30	1925	0.81	1927	6.44	21/1916
February	17.59	1961[1]	1.16	1911	7.02	18/1961[1]
March	15.10	1943	0.34	1955	5.19	14/1929
April	14.85	1900	0.01	1925	5.94	16/1900
May	13.92	1907	0.25	1951	6.16	15/1942
June	18.48	1900	0.08	1936	5.46	12/1900
July	15.23	1916	1.77	1918	5.70	31/1926
August	10.70	1920	0.19	1976	4.00	16/1915[2]
September	14.82	1958	0.24	1953	8.00	29/1915
October	14.53	1918	0.00	1891 - 1952 1963 - 1978	3.95	18/1937
November	15.15	1948	0.34	1908	5.92	27/1948
December	14.79	1953	1.57	1980	6.44	10/1947

[1]February 1961 Flood
[2]September 1915 Hurricane

LAND USE

Urban development is the dominant land use in the Gordons Creek watershed. One exception is an approximately 1,000-acre tract of pine and pine/hardwoods in the southwestern drainage limits. The primary type of development throughout most of the basin is residential, with the exception of business and municipal development immediately downtown and near the Highway 11 and 49 bridge crossings. The most drastic land use change within the last ten years has been the rapid residential development west of Highway 49. The area, known locally as the Lincoln Road extension, was primarily forested flood plain in 1964. However, practically the entire flood plain is now developed with expensive residences.

The upper Burketts Creek watershed west of U.S. Highway 49 is relatively undeveloped. This area is presently located far enough away from the city limits to restrict the type of larger scale development that characterizes Gordons Creek. The primary land use in this area is forest with pine and pine/hardwood associations dominating the area. The watershed east of U.S. Highway 49 is more developed, particularly near Edwards Street. Several intermittent tributaries enter Burketts Creek from the north and are predominantly bordered by a low income residential area. Downstream from the Illinois Central Railroad crossing the stream apparently has been channelized around the three Hattiesburg sewage treatment ponds.

Future land use predictions indicate that the Hattiesburg area will continue to experience growth. In addition, the Burketts Creek drainage basin is expected to also be developed. As the city continues to expand to the southwest, the Burketts Creek drainage area will undoubtably become attractive as prime development land.

SOCIOECONOMIC SETTING

Hattiesburg, which is the capital seat of Forrest County, serves as a primary trade center for southern Mississippi and is also a center of educational and governmental activity. As a result of the importance of the city to the surrounding region of Mississippi, a substantial number of people live in the area. In 1980, Hattiesburg and Forrest County had populations of

40,889 and 66,018, respectively. This represents a 6.8 percent increase in the 1970 population for the city of Hattiesburg and 14.1 percent for Forrest County. This compares with the increment of population growth for the period between 1960 and 1970 of 9.4 percent for Hattiesburg and 9.7 percent for Forrest County. In other words, the population of the area is continuing to grow, with an increasing trend for this population to expand into areas outside of the Hattiesburg city limits.

The Gordons Creek drainage basin has in the last 30 years been the fastest growing section of the city. This is supported by Figure 2, which shows the amount of urbanization as of 1980 which has occurred in the Gordons Creek drainage basin since 1964. As is evident on Figure 2, considerable development has also occurred over much of the Lamar County portion of the Gordons Creek drainage basin, the population figures of which are not reflected above.

Table 3 presents past, existing, and projected population levels in Forrest County, Lamar County, and Hattiesburg to the year 2000. According to the city of Hattiesburg and the Lamar County Planning Commission, the remaining undeveloped portions of the Gordons Creek drainage basin are projected to be converted to residential land uses by the year 2000.

AESTHETICS

From an aesthetic standpoint, Gordons Creek is typical of streams traversing urban areas. The surroundings on either side of the creek vary from a narrow strip of bottomland vegetation at its confluence with the Leaf River,

Table 3
Population of the City of Hattiesburg,
Forrest and Lamar Counties

Area	1960	1970	1980	1990	2000
Forrest County	52,722	57,849	66,018	75,849[1]	84,207[1]
Lamar County	13,675	15,209	23,821	26,924[1]	29,582[1]
Hattiesburg (Total)	34,989	38,277	40,829	44,000[2]	46,300[2]
Hattiesburg (Lamar County Portion)	-	284	1,142	-	-

SOURCE: US Census Bureau, various publications
[1]OBERS Projections for Mississippi by County (draft), Bureau of Economic Analysis, Department of Commerce, 1982.
[2]Corps of Engineers (Mobile District), based on a gradually decreasing share of Forrest County total.

to commercial and residential developments over much of its length, to a short reach of pasture and pine forest land in its headwater reaches. Although commercial businesses and relatively small undeveloped lots occur along the stream, residential lawns are by far the dominant features of the landscape. Depending upon the neighborhood and individual property owners adjacent to the stream, these lawns vary from being well manicured to unkempt. The actual banks along the majority of the stream are characterized by scrubby vegetation and various vines, brambles, and plants typical of disturbed areas. There are also many bridges crossing the creek at close intervals which detract from the stream's natural appearance and a portion of the stream channel has been totally lined with concrete, further detracting from its visual qualities.

Burketts Creek upstream of the Edward Street crossing is a small relatively undisturbed stream running through an area dominated by a mixed pine-hardwood forest. Below the Edward Street crossing, however, conditions are

very similar to those surrounding upper Gordons Creek with the area dominated by industrial and municipal development.

HYDROLOGY

The hydrologic and hydraulic characteristics of a stream are important habitat variables which influence its aquatic community. The magnitude, duration, and frequency of occurrence of various magnitudes of flow are important determinants (as are water quality, sediments, and a number of other parameters) of the types of plants and animals found in the stream.

The natural hydrology of the Gordons Creek drainage basin has been significantly altered by urbanization. No discharge gaging stations are maintained on Gordons Creek. However, Table 4 presents the average monthly and annual flows synthetically computed for the mouth and at Broad Street. When these flows are compared to the discharge of 6,750 cfs measured near the crest of the recent 6 and 7 April 1983 flood, it is readily apparent that Gordons Creek supports a very small base flow and is subject to both flashy periods of discharge and the backwater effects of flooding on the Leaf River.

No discharge data is available for Burketts Creek. However, it also supports a small base flow and is subject to periods of high discharge and backwater effects of flooding on the Leaf River.

Table 4

Average Monthly and Annual Flows (cfs)[1] for Gordons Creek

Month	Mouth (Mile 0)	Broad Street (Mile 2.35)
January	20.3	17.9
February	29.3	25.9
March	29.8	26.3
April	24.9	22.0
May	14.9	13.2
June	7.7	6.8
July	9.3	8.2
August	6.5	5.7
September	6.3	5.5
October	5.0	4.4
November	9.0	7.9
December	15.3	13.5
Annual	14.8	13.0

[1]Flows computed synthetically considering average monthly rainfall, discharge data from the Leaf River, and assuming a relationship exists between the size of the drainage basin and discharge.

WATER QUALITY

Very little information on the water quality of Gordons Creek is available. The stream is classified by the Mississippi Bureau of Pollution Control for fish and wildlife use. As stated previously, Gordons Creek provides an outlet for approximately 75 percent of the city of Hattiesburg's drainage. Only one recognized point source discharge (a carwash near Broad Street) enters the creek; however, numerous drainage pipes empty into the stream at various points within the study area. The stream within the study area does not support appreciable aquatic life. The reach of the stream within the business district suffers from general neglect with trash and debris being scattered throughout much of the length of the stream.

Despite the fact that Gordons Creek flows through a highly urbanized area, the stream has not historically experienced significant water quality problems. As would be expected of an urban stream, nonpoint surface runoff contributes coliform bacteria and nutrients during storm events. Dr. Gordon Godshalk of the University of Southern Mississippi (personal communication) has occasionally sampled the stream for coliform bacteria as a field exercise with his classes. The limited data he and his classes have collected reveal that relatively high levels of coliform occur in the creek; however, these levels are not high enough to warrant significant concern.

The segment of Gordons Creek from the vicinity of Broad Street downstream to its confluence with the Leaf River is classified by the 1978 Mississippi Statewide 208 Water Quality Management Plan as effluent limited. This classification is assigned to those streams where it is known that water quality is meeting, and will continue to meet, applicable water quality standards or where there is adequate evidence that water quality will meet applicable water quality standards after the application of effluent limitations required by Sections 301(b)(1)(B) and 301(b)(2)(A) of the Clean Water Act of 1977. The only recognized point source entering Gordons Creek, as previously mentioned, is located at the upstream limit of the effluent limited stream segment. The source of this discharge is a car wash with a reported volume of about .0140 million gallons per day with dissolved oxygen levels measured at 6.5mg/l.

Limited historical water quality data for Gordons Creek, as well as for the Leaf and Bowie Rivers, is provided by a short-term intensive water quality study conducted by the US Geological Survey of these streams on 16, 17, and

18 October 1973. The study was performed in order to provide information on area water quality for the Pat Harrison Waterway District. Table 5 contains the results of the analyses performed at three sample stations: Gordons Creek at the West Pine Street bridge, Leaf River at the River Avenue bridge, and the mouth of Bowie River (see Figure 3). According to the results of this investigation, relatively high levels of ammonia nitrogen, total phosphorus, and fecal coliform were present at the time of sampling, which is fairly indicative of an urbanized stream. Observed temperature, pH, dissolved oxygen, and specific conductance, however, were all within suitable limits.

The water quality conditions in Burketts Creek are highly variable due to the change in surrounding land use from its headwaters to the mouth. The western part of the channel appears to have retained natural characteristics and tolerable water quality because of the lack of disturbance and channel modification in the creek. Water quality conditions appear to decline downstream from the Edwards Street bridge crossing due to the proximity of industrial and municipal development.

AIR QUALITY

Air quality for the entire State of Mississippi is considered good. In 1980, the primary ambient air quality standard was violated in Laurel, which is approximately 30 miles northeast of the study area. The Mississippi Bureau of Pollution Control, however, believes the Laurel area is now in compliance with applicable standards as a result of corrective actions taken in accordance with the State Implementation Plan revision approved by the EPA. The Hattiesburg area is in compliance with Mississippi State standards.

Table 5

Data from U. S. Geological Survey Water Quality Study of Selected Stations
Utilized During Short-term Intensive Study Done for Pat Harrison Waterway District

Station	Date Oct. 1973	Time	Dis-charge (cfs)	Ammonia Nitrogen (N) (mg/l)	Organic Nitrogen (N) (mg/l)	Total Kjedahl Nitrogen (N) (mg/l)	Total Phos-phorus (P) (mg/l)	Specific Conduc-tance umhos)	pH	Tempera-ture (°F)	DO (mg/l)	BOD (mg/l)	Total Coliform (Col/100 ml)	Fecal Coliform (Col/100 ml)	[illegible]
Gordons Creek at W. Pine St. bridge	16	0955	1.9	--	--	--	--	105	6.8	73.4	5.7	--	--	--	--
	16	1250	1.9	--	--	--	--	98	6.9	74.3	6.9	--	--	---	--
	16	1635	3.0	--	--	--	--	85	6.7	70.7	7.1	--	--	--	--
	17	0900	4.2	.29	.65	.94	.29	68	6.7	64.4	8.1	3.7	>50,000	>14,000	[illegible]
	17	1245	3.7	.35	.62	.97	.18	54	6.5	67.1	8.7	3.7	>50,000	>14,000	[illegible]
	17	1315	3.2	.38	.62	1.00	.22	70	6.8	68.0	8.5	3.6	--	--	--
	17	1910	2.7	.39	.11	.50	.23	85	6.7	67.1	8.3	4.1	>50,000	>14,000	>500
	17	2350	2.7	.66	.44	1.10	.23	90	6.8	64.4	8.0	3.0	--	--	--
	18	0325	2.4	1.10	.40	1.50	.37	100	6.7	62.6	7.9	--	>50,000	>14,000	[illegible]
	18	0700	1.9	1.30	.50	1.80	.76	110	6.8	59.9	7.8	3.3	--	--	--
	18	1110	1.9	--	--	--	--	128	6.6	62.6	8.8	--	--	--	--
	18	1400	1.8	--	--	--	--	130	6.8	67.1	8.6	--	--	--	
	18	1420	1.7	--	--	--	--	130	6.6	65.3	7.9	--	--	--	--
Leaf River at River Ave. bridge	16	0935	865	--	--	--	--	62	6.6	74.3	6.2	--	--	--	--
	16	1350	875	--	--	--	--	59	6.8	74.3	6.1	--	--	--	--
	17	1000	1,000	.27	.35	.62	.10	60	6.6	69.8	7.2	2.3	300	>14,000	390
	17	1330	1,050	.17	.36	.53	.19	70	6.7	71.6	7.3	2.8	--	--	--
	17	1610	1,180	.32	.88	1.20	.19	60	6.9	72.5	7.5	10.0	180,000	>14,000	[illegible]
	17	1955	1,230	.34	.56	.90	.22	57	6.7	71.6	7.6	5.0	40,000	>14,000	--
	18	2445	1,250	.30	1.50	1.80	.15	59	6.9	69.8	7.6	3.5	80,000	>14,000	[illegible]
	18	0400	1,260	.35	.36	.71	.12	58	6.9	68.0	7.6	2.1	--	--	--
	18	0740	1,300	.39	.46	.85	.14	56	6.8	68.0	7.9	2.0	--	--	--
	18	1140	1,310	--	--	--	--	57	6.3	69.8	8.9	--	--	--	--
	18	1445	1,300	--	--	--	--	--	--	70.7	8.2	--	--	--	--
	18	1710	1,290	--	--	--	--	65	6.8	70.7	7.9	--	--	--	--
Bowie River at mouth	16	0830	502	--	--	--	--	57	6.3	74.3	5.7	--	--	--	--
	16	1225	502	--	--	--	--	62	6.5	75.2	5.3	--	--	--	--
	17	0940	637	.48	.62	1.10	.19	60	6.2	71.6	5.8	3.9	21,000	>5,000	220
	17	1130	667	.34	.41	.75	.34	53	6.4	73.4	6.1	6.3	27,000	>5,000	240
	17	1510	696	.57	.39	.96	.35	50	6.4	73.4	6.0	6.3	45,000	>5,000	180
	17	1805	714	.55	.85	1.40	.38	60	6.4	72.5	6.4	7.1	30,000	>5,000	240
	17	2340	743	.60	.24	.84	.20	56	6.5	71.6	6.8	4.4	--	--	--
	18	0310	749	.63	.37	1.00	.23	48	6.4	71.6	6.6	3.8	100,000	>5,000	220
	18	0650	758	.73	.47	1.20	.24	50	6.4	70.7	6.9	2.9	--	--	--
	18	1055	767	--	--	--	--	58	6.2	69.8	7.2	--	--	--	--
	18	1320	773	--	--	--	--	53	6.3	70.7	6.8	--	--	--	--
	18	1530	770	--	--	--	--	50	6.0	71.6	--	--	--	--	--

FISH AND WILDLIFE RESOURCES

From the foregoing discussion, it is readily apparent that much of the Gordons Creek drainage basin has been altered by urbanization. In fact, all of the lands adjacent to Gordons Creek, with the exception of a portion of a few headwater tributary streams supporting intermittent flow, have been developed. As a result much of the natural stream has been modified to increase channel capacity and conveyance for flood control purposes.

Figure 2 shows the existing major habitat types present within the Gordons Creek and Burketts Creek drainage basin. There are isolated areas of varying sizes scattered along Gordons Creek which have not yet been developed. However, due to their small size and proximity to various urban activities, they are of little value to wildlife, serving primarily as refuge for certain animals and providing permanent habitat for other wildlife whose continued existence in the area is compatible with man's activities. For the most part, the only relatively undeveloped areas within the drainage basin are restricted to the extreme southwestern portion of the basin away from the stream and possibly total an area of less than 1,000 acres. Even these areas, according to available 1980 photography, have been disturbed by roads and scattered buildings. Despite these activities, stands of native vegetation do occur in the area. As previously discussed on page 4-12, based on the level of previous development and historical trends in the drainage basin, it is very likely that these areas will also be subjected to residential developments by the year 2000, provided an improved economy encourages additional construction.

The presence of wildlife species in an area is generally governed by available vegetative communities, although other factors certainly influence the actual utilization of these habitats. A variety of terrestrial habitats are located in the drainage basin (see Figure 2); however, the diversity of habitat along Gordons Creek proper is limited. A fringe of bottomland hardwood habitat occurs in the area where Gordons Creek enters the Leaf River. Typical tree species characterizing this habitat type include swamp chestnut oak (Quercus michauxii), red maple (Acer rubrum), overcup oak (Q. lyrata), water oak (Q. nigra), and black gum (Nyssa sylvatica). The plant community existing along the stream banks downstream of the vicinity of the US Highways 49 and 11 interchange is characteristic of an urban stream, flowing through older established neighborhoods and commercial areas. The area supports scattered large sycamores (Platanus occidentalis) and pecan (Carga illinoensis) trees and numerous smaller trees such as black willow (Salix nigra), catalpa (Catalpa speciosa), honeylocust (Gleditsia triacanthos), and sweetgum (Liquidambar styraciflua).

Vegetation along the lower 2.35 miles was selectively removed during construction of the existing project which was completed in 1979. This is particularly true of the reach between stream miles 1.11 and 2.35 in which the stream channel was enlarged. Upstream of the upper limits of the existing project to the Highways 49 and 11 interchange, the areas adjacent to the stream range from unkempt lots supporting various stages of successional vegetation to well manicured residential lawns.

Above the Highways 49 and 11 interchange, a small strip of riparian vegetation still persists along the stream despite the extensive residential developments which have occurred in the area in recent years. Land areas away from the immediate streambanks are typically dominated by longleaf pine (Pinus palustris) forests. The scope of these forested areas have been reduced in the residential areas and many ornamental shrubs and lawns are now prominent features of the available habitat.

At the Forrest-Lamar County line, the mainstem of Gordons Creek leaves the residential areas and turns to the southwest where it extends approximately upstream one mile before being designated as an intermittent stream by the US Geological Survey. In this reach the stream flows through both cleared pasture or abandoned agricultural areas and relatively undisturbed pine forests. From a wildlife perspective, the highest quality habitat is located along this reach of the creek.

The watershed of Burketts Creek is capable of supporting a wide variety of wildlife species. Upstream of the Edwards Street crossing, vegetative species composition is dominated by longleaf pine on the uplands and a mixture of hardwoods in the flood plain such as water oak, willow oak, red maple, and sweetgum. Population of amphibians, reptiles, mammals, and passerine birds can be expected to inhabit this area. Big game species such as whitetailed deer and wild turkey should occur in the drainage basin. Downstream of the Edwards Street crossing, wildlife conditions become very similar to those found along Gordons Creek. Industrial and municipal development have substantially reduced the quantity and quality of habitat, thereby reducing the number and diversity of wildlife species capable of inhabiting the area.

According to the Environmental Impact Statement prepared in 1976 for the existing project on Gordons Creek, the following groups of wildlife species (and number of species in each group) could occur in the drainage basin based on information of their known ranges: 19 salamanders, 23 toads and frogs, the American alligator, 20 turtles, 13 lizards, 37 snakes, 33 mammals, and over 200 birds. In connection with the Corps of Engineers flood control study of the Leaf and Bowie Rivers, the US Fish and Wildlife Service also prepared an extensive list of animals which could occur within the drainage basin, provided suitable habitat is available and the presence of man is not a disrupting influence. However, due to the intense activities of man in the area, it is highly probable that only a small number of these animals compose the actual faunal community along and within the creek. With the exception of isolated instances, the terrestrial fauna of these areas immediately adjacent to Gordons Creek is dominated by songbirds, squirrels, opossum, rabbits, a few species of reptiles, and rodents. Big game species such as whitetailed deer (Odocoileus virginianus) and turkey (Meleagris gallopavo) would be limited to uncommon occurrences of individuals in the extreme upper reaches of the stream. No waterfowl or furbearing animals are known to use Gordons Creek on a regular basis.

The Pascagoula River basin, of which Gordons Creek is a component, supports a rich and diverse fish fauna. It is very likely that the fish community of Gordons Creek is composed of representatives of the same species which inhabit the Pascagoula basin. The most recent fishery investigations performed near the study area was conducted by Boschung and Schiering in 1981, under contract to the Corps of Engineers. They collected 46 species, representing 26 genera and 11 families, from four stations on the Leaf and Bowie

Rivers in the vicinity of the mouth of Gordons Creek. Of these, four species represented over 67 percent of all fish collected: silverjaw minnow (Ericymba buccata), longnose shiner (Notropis longirostris), blacktail shiner (Notropis venustus), and longear sunfish (Lepomis megalotis). Important game fishes collected include longear sunfish, bluegill (Lepomis macrochirus), and spotted bass (Micropterus punctulatus). Most of the fish occurring in Gordons Creek are probably transient adults or juvenile stages which utilize the lower stream reaches as a nursery area. The extensive developments in the basin, small volume of dependable base flow, and the general lack of high quality aquatic habitat combine to create an insignificant resident fish fauna.

The aquatic habitat conditions in Burketts Creek are highly variable. In the western part of the watershed, forests predominate as there is little development and no apparent channel modifications. Although the stream is relatively small in this area, it appears to be capable of supporting many of the present species mentioned in the previous paragraph. Instream habitat conditions appear to be fairly good downstream to near the Edward Street bridge crossing. Habitat conditions rapidly decline downstream from this point and appear to be substantially reduced in the vicinity of the Hattiesburg sewage treatment facility.

The study area is within the reported range of a number of Department of Interior designated endangered and threatened species. Species included on the endangered list are the bald eagle (Haliaeetus leucocephalus), peregrine falcon (Falco peregrinus tundrius), ivory-billed woodpecker (Campephilus principalis), Bachman's warbler (Vermivora bachmanii), red-cockaded woodpecker

(Picoides borealis), Florida panther (Felis concolor coryi), and the American alligator (Alligator mississippiensis). Species listed as threatened whose range includes the study area is the Eastern indigo snake (Drymarchon corais couperi) which is possibly extinct in Mississippi. No critical habitats have been designated within the study area. According to the US Fish and Wildlife Service, only the American alligator has been specifically identified as occurring near the study area. Due to the disturbance of habitat by man in the Gordons Creek drainage basin, it is doubtful whether any of these species would occur in the area.

CULTURAL RESOURCES

Three historic properties within the city of Hattiesburg (the US District Courthouse, the Hub City Historic District, and Tall Pines) are currently listed on the National Register of Historic Places. However, none of these properties are located within the immediate vicinity of Gordons Creek. The Mississippi State Historic Preservation Officer (SHPO) was also contacted concerning information on prehistoric and historic sites and properties along Gordons Creek between Broad Street and Interstate 59 that could possibly be eligible for inclusion on the National Register.

As of November 1979, there were 33 recorded prehistoric archaeological sites in Forrest County. None of these sites are currently listed on or have been determined eligible for inclusion on the National Register of Historic Places. However, it is the opinion of the Mississippi SHPO that some of the sites are potentially eligible for the National Register.

On 1 November 1982, Mobile District archaeologists conducted a cultural resource survey of the lands immediately adjacent to the upper portion of Gordons Creek between Broad Street and Interstate 59. No cultural resources were noted during this survey. Based upon the extensive disturbance of the areas by recent activities, it is highly doubtful that any intact archaeological sites still exist along the banks of the stream. The report of this survey was filed with the Mississippi SHPO on 5 November 1982.

In summary, no archaeological or historic sites, properties, or remains are located along the banks of Gordons Creek. Contact with the Mississippi SHPO also revealed no pending nominations for the National Register, nor any previously recorded archaeological sites in the immediate vicinity of Gordons Creek.

RESOURCE PROBLEMS AND NEEDS

The extensive development in the Gordons Creek and Burketts Creek drainage basins has severely disturbed the natural qualities of the study area. Quality wildlife habitat along the banks of either creek in most areas is lacking due to urban development right up to the boundary of the creek channel. Preserving and maintaining a green belt along the immediate edges of the creek bank would be desirable. However, the urban nature of the stream makes this an infeasible option along much of the stream reach. The overall urban nature of the study area prevents extensive wildlife use in either drainage.

Water quality in the study area is heavily influenced by surface runoff. Although no extreme water quality problems are presently occurring, increased urbanization could contribute to future water quality problems as is often the trend in developed areas. Water quality changes should be closely monitored in the future.

The previous flood control project on the lower portion of Gordons Creek has contributed to the limited wildlife use of the stream channel and immediate vicinity. Urbanization pressures in the authorized portions of the creek has led to dwindling green areas along the stream banks. Clearing and snagging or channelization in the upper portions of the study area can be expected to continue to preclude extensive wildlife use in the study area.

Other flood control measures to consider would include nonstructural flood control measures. However, due to the need to protect existing development it would be necessary to examine these types of options closely to determine if they would respond to the area's needs. Sound future planning by the city would need to include restrictions of development in flood prone areas.

DATA GAPS

As previously discussed, very little information on the water quality of Gordons Creek or Burketts Creek is available. Data is also scarce on land use trends, although previous intensive development indicates future trends would be expected to be similar.

In addition, a cultural resources survey has yet to be accomplished for the Burketts Creek area. A survey of this area is planned for the near future and the results will be included in a later project report.

A CULTURAL RESOURCE SURVEY OF THE UPPER GORDONS CREEK FLOOD CONTROL PROJECT, FORREST COUNTY, MISSISSIPPI

Prepared by:
U.S. Army Engineers District, Mobile, Alabama
Corps of Engineers

4 November 1982

Under several historic preservation laws and Executive Order 11593, dated 13 May 1971, the Corps of Engineers has the responsibility to identify and preserve cultural resources, or mitigate losses thereto, on lands under their jurisdiction. The pertinent authorities for this responsibility include the Antiquities Act of 1906, the Historic Sites Act of 1935, the National Historic Preservation Act of 1966 as amended including the National Historic Preservation Act Amendments of 1980, the Reservoir Salvage Act of 1960 as amended by the Archeological and Historical Preservation Act of 1974, Executive Order 11593, the Archeological Resources Protection Act of 1979, and the National Environmental Policy Act.

In compliance with these authorities, a cultural resource survey was performed to examine a proposed flood damage prevention project on upper Gordons Creek, Forrest County, Mississippi (Figure 1).

Project Description

In order to prevent flood damage on upper Gordons Creek, the Mobile District Corps of Engineers is proposing to enlarge the existing creek channel. The Corps worked on the lower 2.35 miles of Gordons Creek in 1979. Upper Gordons Creek flows principally through some of the newer residential and business sections of Hattiesburg.

Literature and Records Search

Gordons Creek is named after either William Scott Gordon or Green B. Gordon, both early nineteenth century settlers in this area. This region was used primarily for agricultural purposes until William Harris Hardy founded Hattiesburg in 1880. The town was situated at the intersection of the New Orleans and North Eastern railroad and the Gulf and Ship Island railroad. The older portion of the town is located outside the project area near the intersection of the Bowie and Leaf rivers. A review of the National Register of Historic Places has shown no registered properties to be located within this study area. No known sites have been previously recorded for this area (Smith 1969, Watson 1974).

Survey Results

On 1 November 1982, Mr. Neil Robison and Mr. Charles Moorehead, Mobile District archeologists, examined the upper Gordons Creek project area for cultural resources. To examine the creek and surrounding land, the surveyors drove along the stream and crossed each intersection which passed over the creek. All areas which were thought to have archeological potential were examined on foot.

Gordons Creek, which is the principal drainage for the City of Hattiesburg, has been drastically altered by recent developments. Large portions of the stream have already been straightened and certain segments have been lined with concrete or cemented stones. Excepting the upper most portion of the creek, the stream banks are lined by residential yards and commercial developments. The most western portion of the creek runs through a very flat pine woods area under a powerline. This part of the creek appears to have been channelized and the adjacent banks under the power line were probably leveled by a buildozer.

None of the houses adjacent to the project area appear to have been built before the late 1940's. Many of the housing and apartment complexes along the western portion of the stream were probably built in the 1970's. All of the bridges in the project area were modern concrete structures. The oldest dated bridge was built in 1937.

No cultural resources were noted during an examination of the project area. Based upon the drastic disturbances to the area it is highly doubtful that any intact archeological sites still exist along the banks of Gordons Creek.

Summary and Recommendations

No archeological or historic sites, properties or remains were located within the project area. A literature and records review showed no properties to be affected by the project and contact with the Mississippi State Historic Preservation Officer revealed no pending nominations for the National Register, nor any previously recorded archeological sites within the proposed project area.

N. Robison

Neil Robison
Archeologist
Environmental Compliance Section

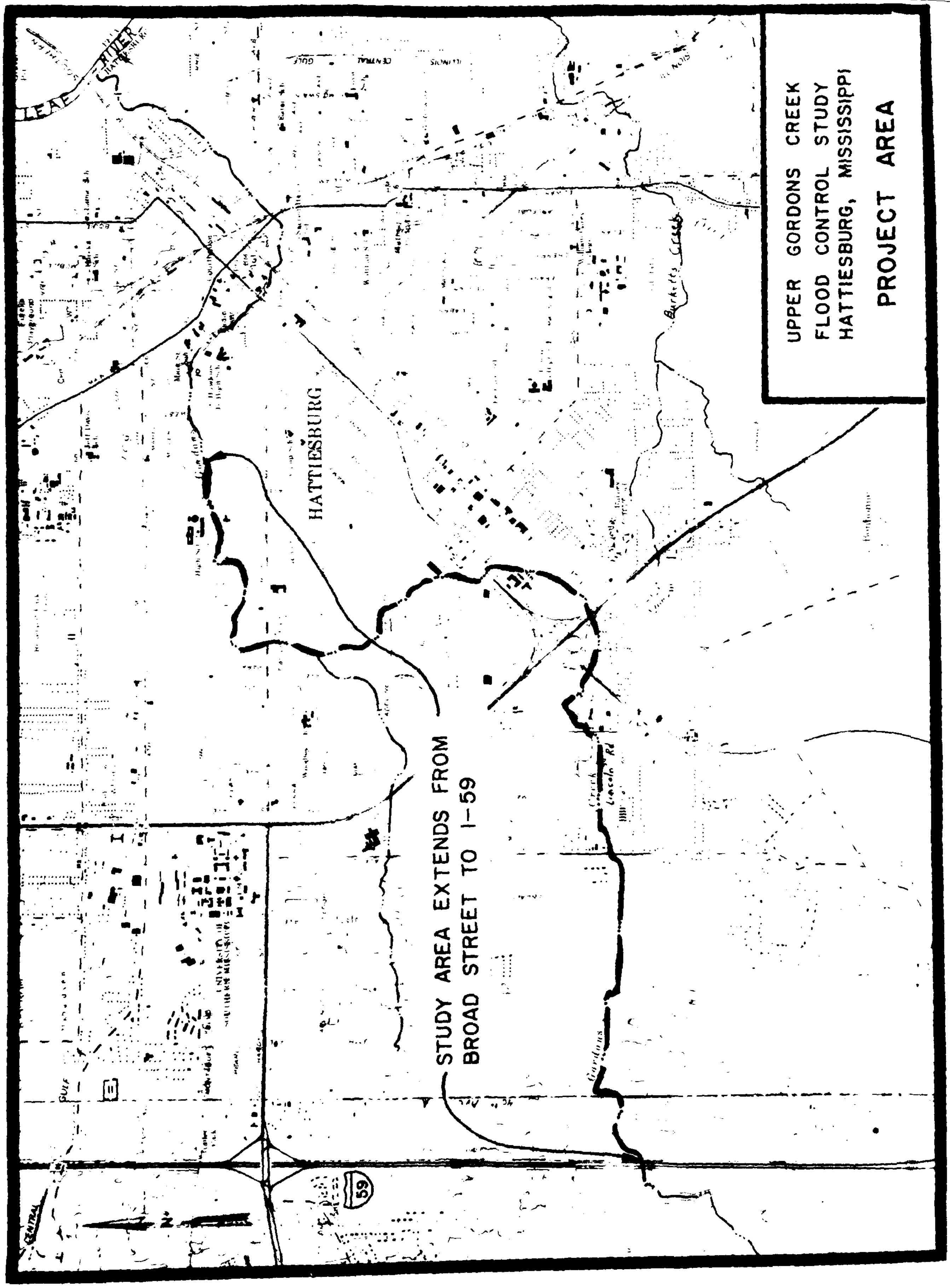
Charles Moorehead

Charles Moorehead
Archeolgoist
Environmental Compliance Section

<u>References</u>

Smith, Jack Alan
1969 *A Study of Place-Names in Forrest County, Mississippi*. A dissertation submitted to Auburn University, Auburn, Alabama.

Watson, George R., Sr.
1974 *Historical Hattiesburg*. Volume privately published by author.


UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
PROJECT AREA
HATTIESBURG
STUDY AREA EXTENDS FROM
BROAD STREET TO I-59
59

A CULTURAL RESOURCE SURVEY OF AREAS WHICH MAY POTENTIALLY BE ADDED TO THE UPPER GORDONS CREEK FLOOD CONTROL PROJECT, FORREST COUNTY, MISSISSIPPI

Prepared by
U.S. Army Engineers District, Mobile, Alabama
Corps of Engineers

13 July 1984

Under several historic preservation laws and Executive Order 11593, dated 13 May 1971, the Corps of Engineers has the responsibility to identify and preserve cultural resources, or mitigate losses thereto, on lands under their jurisdiction. The pertinent authorities for this responsibility include the Antiquities Act of 1906, the Historic Sites Act of 1935, the National Historic Preservation Act of 1966 as amended including the National Historic Preservation Act Amendments of 1980, the Reservoir Salvage Act of 1960 as amended by the Archeological and Historical Preservation Act of 1974, Executive Order 11593, the Archeological Resources Protection Act of 1979, and the National Environmental Policy Act.

In compliance with these authorities, a cultural resource survey was performed to examine portions of a flood damage prevention project on upper Gordons Creek and Burketts Creek, Forrest County, Mississippi (Figure 1).

Project Description

An earlier report on the upper Gordons Creek flood control project was submitted to the Mississippi State Historic Preservation Officer in November of 1982. Since that time several areas have been considered for addition to the project. These areas include a tributary of Gordons Creek, a proposed diversion channel from Gordons Creek to a tributary of Burketts Creek, and one of two tributaries of Burketts Creek. The Gordons Creek and Burketts Creek tributaries, if included in the project, would be cleared and snagged and potentially undergo some channel improvement.

Literature and Records Search

A review of the National Register of Historic Places has shown no registered properties to be located within the study areas. No known sites have been previously recorded for these areas.

Survey Results

On 10 July 1984, Mr. Neil Robison, Mobile District archeologist, examined the additional study areas being considered for this project. To initially examine the creeks and the surrounding land, the surveyor drove along the streams and crossed each intersection which passed over the water courses. All areas which were thought to have archeological potential were examined on foot.

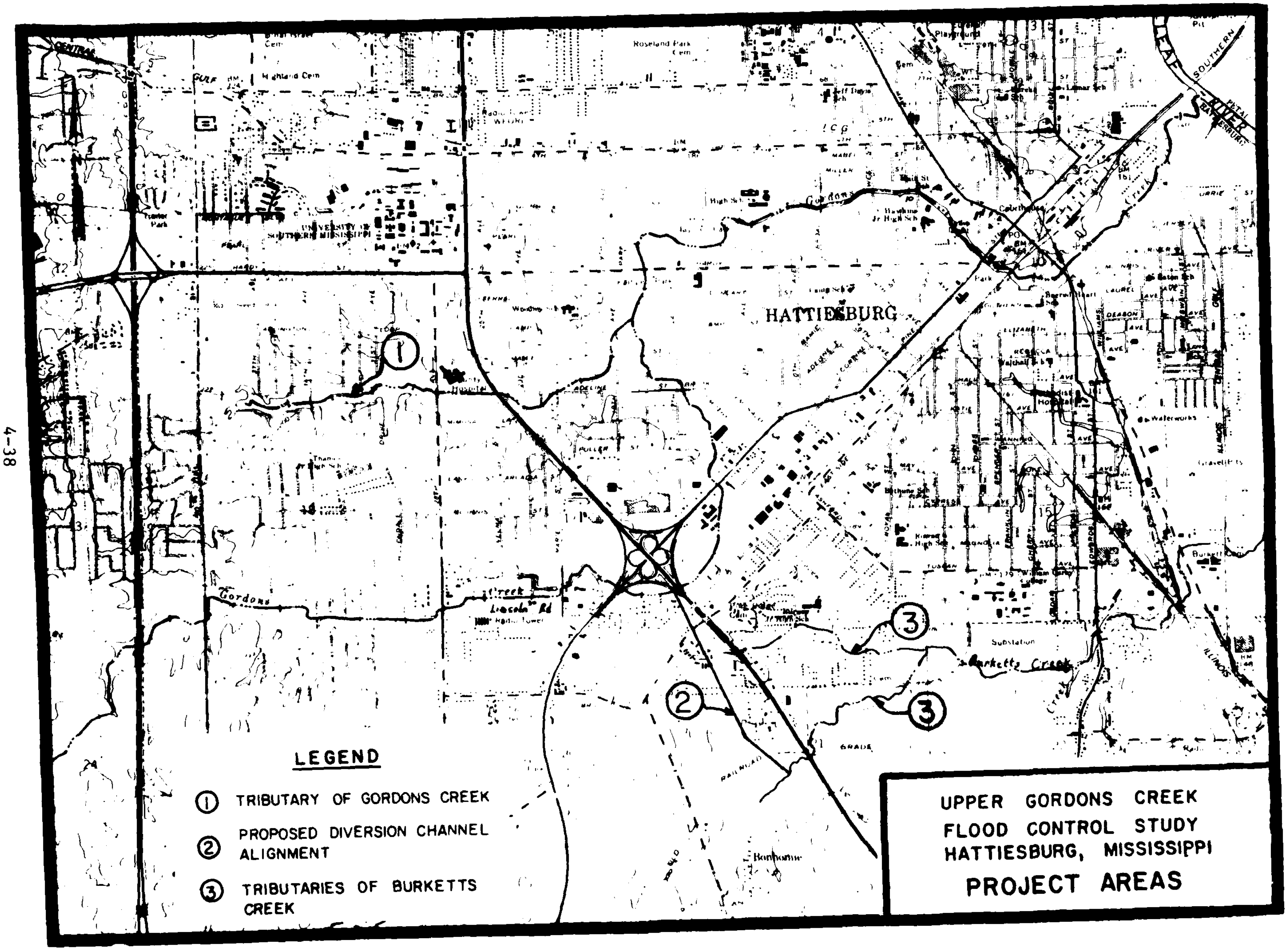
The Gordons Creek tributary to be affected is situated in a highly urbanized portion of Hattiesburg. Most of the creek banks abut the back yards of houses. Portions of the creek have been channelized and in many areas private land owners or the city have armored the creek banks with concrete or rock rubble to prevent erosion. The extensive disturbance to this creek and its adjacent banks virtually preclude any potential for preserved archeological remains.

The Alternative diversion channel from Gordons Creek to a tributary of Burketts Creek is to run roughly parallel to Highway 49. The majority of the channel is to be placed in the road right-of-way or in vacant lots between houses in a less densely populated part of town. Part of the channel is proposed to be placed in an open area that is currently being developed as a building subdivision. An examination of the proposed alignment for the diversion channel found a majority of the area to be quite disturbed. No cultural resource materials were found during an examination of the area.

Two tributaries of Burketts Creek are currently being considered for utilization to carry the excess waters diverted from Gordons Creek, if the plan is carried through only one will actually be utilized. Clearing and snagging and some channel work on one of these streams may be necessary to improve its water carrying capacity. The more northernly of the two tributaries in only an intermittant stream and runs through a developed area. Because of the disturbances of this area it is felt that there is a very low potential for intact cultural resources being present. The more southernly of the two tributaries flows through an undeveloped wooded area. Foot surveys were conducted through this area and numerous shovel tests were excavated. Those areas which may potentially be affected are all directly in the creek floodplain and frequently flooded. No cultural materials were found on the ground surface or in the shovel tests.

Summary and Recommendations

No archeological or historic sites, properties or remains were located within the study areas examined. A literature and records review showed no properties to be affected by the project and contact with the Mississippi State Historic Preservation Officer revealed no pending nominations for the National Register, nor any previously recorded archeological sites within the proposed project areas.


UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
PROJECT AREAS
LEGEND
① TRIBUTARY OF GORDONS CREEK
② PROPOSED DIVERSION CHANNEL ALIGNMENT
③ TRIBUTARIES OF BURKETTS CREEK
HATTIESBURG
Gordons Creek
Burketts Creek
UNIVERSITY OF SOUTHERN MISSISSIPPI
Roseland Park Cem
Highland Cem
Substation
Bonhomie
Waterworks
Lincoln Rd
SOUTHERN
RIVER
PETAL
ILLINOIS

SECTION 404(b)(1) EVALUATION

FOR

UPPER GORDONS CREEK

HATTIESBURG, MISSISSIPPI

Prepared by

U. S. Army Engineer District, Mobile, Alabama

April 1985

SECTION 404(b)(1) EVALUATION
FOR
UPPER GORDONS CREEK
HATTIESBURG, MISSISSIPPI

1. PROJECT DESCRIPTION. The proposed plan for providing flood protection along Upper Gordons Creek would involve a combination of bank clearing and grubbing, channel widening, modification of two highway bridges, evacuation and removal of several structures, relocation of 20 utility lines, and the placement of approximately 12,830 cubic yards (cy) of riprap along some curves and at bridge crossings for erosion protection. Of the preceding actions, only the placement of riprap is governed by the Section 404(b)(1) guidelines and is addressed in this evaluation. Approximately 25,770 square yards of filter cloth and 4,490 cy of bedding material would be placed prior to the riprap.

a. Authority and Purpose. Authority for this study and report was provided by Section 205 of the Flood Control Act of 1948. The purpose of the study was to investigate the flooding situation along Upper Gordons Creek and develop a plan to relieve or reduce the flood damages.

b. Description of the Proposed Fill Materials.

(1) General Characteristics. The fill materials which would be placed along curves and bridge crossings consist of riprap over bedding material and filter cloth. The average stone weight would be approximately 90 pounds.

(2) Quantity of Material Proposed for Discharge. About 12,830 c.y. of riprap and 4,490 cy of bedding material would be placed on 25,770 square yards of filter cloth.

(3) Source of Materials. The filter cloth, bedding material, and riprap would be obtained from commercial sources.

c. Description of the Proposed Discharge Sites.

(1) Location and Areal Extent. The discharge sites are located at 15 bridge crossings and along the bank slopes of various curves where erosion is most severe, for a total of approximately 5,870 feet along the creek. Approximately 7 acres would be covered by riprap. Discharge sites are shown on Chart Nos. 2-C-12 through 2-C-16 of Appendix 2.

(2) Types of Discharge Sites. The discharge sites are creek bottoms and bank slopes at bridge crossings and bank slopes along some curves.

(3) Method of Discharge. The riprap would be trucked to the sites and placed from the channel.

(4) When Will Disposal Occur? Disposal is scheduled for FY-87.

(5) Projected Life of Discharge Sites. The fill materials should remain at the site throughout the 50-year project life.

2. FACTUAL DETERMINATIONS.

a. Physical Substrate Determinations

(1) Substrate Elevation and Slope. Riprap at bridge crossings would extend from 5-feet beyond the top of one bank, across the creek bottom, to 5-feet beyond the other top of bank. Riprap at curves would be placed along the entire bank slope from 5-feet along the channel bottom to 5-feet beyond the top of bank. The slope would be 1 vertical on 3 horizontal.

(2) Sediment Type. Refer to Paragraph 1.b.(1) of this evaluation.

(3) Fill Material Movement. Due to the nature of the fill material, movement would be insignificant.

(4) Physical Effect on Benthos. Placement of riprap would destroy any nonmotile organisms living in the immediate areas to be covered. After stabilization of the fill material, organisms common to the area and those requiring hard substrates would colonize the submersed fill material. The new benthic communities would be more diverse than those which presently inhabit the area.

(5) Actions Taken to Minimize Impacts. Placement of riprap would be within a defined area thereby minimizing impacts to benthos.

(b) Water Circulation, Fluctuation, and Salinity Determinations.

(1) Water. There would be no significant impacts on water chemistry, color, odor, taste, dissolved gas levels, nutrients or eutrophication characteristics due to disposal. Water clarity may be temporarily reduced due to disposal activities but should return to normal shortly after construction is completed.

(2) Current Patterns and Circulation. No impact.

(3) Normal Water Level Fluctuations. No impact.

(4) Salinity Gradients. Not applicable.

(5) Actions to Minimize Impacts. Due to the fact that water circulation and fluctuation would not be significantly affected, no actions to minimize impacts would be required.

c. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site. Temporary and localized increase in turbidity levels would occur during disposal activities.

(2) Effects of Chemical and Physical Properties of the Water Column. Slight decrease in dissolved oxygen concentrations would occur during disposal activities.

(3) Effects on Biota. No significant impacts.

(4) Actions Taken to Minimize Impacts. Due to the fact that no significant impacts would occur, no actions to minimize impacts would be required.

d. Contaminant Determinations. No testing was required of the material to be used since riprap has been determined to meet the exclusion criteria under 40 CFR 230.60. The determination was based on the fact that the material is characterized as stone which is sufficiently removed from sources of pollution to provide reasonable assurance that the material would not be contaminated by such pollution and the fact that the material itself is inert.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Benthos. Nonmotile benthic organisms living on or within the area to be covered by riprap would be destroyed. Also refer to paragraph 2.a.(4) of this evaluation.

(2) There would be no significant effects on the aquatic food web, threatened or endangered species or other wildlife.

(3) Actions Taken to Minimize Impacts. There is no need to provide special protection measures since no significant impacts are expected.

f. Proposed Disposal Site Determinations.

(1) Mixing Zone Determination. Not applicable. No aqueous discharge would occur.

(2) Determination of Compliance with Applicable Water Quality Standards. The proposed action would comply with applicable water quality standards. Water quality certification from the Mississippi Bureau of Pollution Control would be obtained prior to any action.

(3) Potential Effects on Human Use Characteristics. The placement of riprap would result in erosion protection at bridge crossings and curves.

g. Determination of Cumulative Effects on the Aquatic Ecosystem. Cumulative effects would be negligible as discharge would only occur once.

h. Determination of Secondary Effects on the Aquatic Ecosystem. Placement of riprap should not result in any secondary effects.

3. FINDINGS OF COMPLIANCE OR NON-COMPLIANCE WITH THE RESTRICTIONS ON DISCHARGE.

a. No significant adaptations of the guidelines were made relative to this evaluation.

b. The planned discharge of fill materials would not violate any applicable State water quality standards. The disposal operation would not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

c. Use of the proposed sites would not harm any endangered species or their critical habitat.

d. The proposed discharge of fill materials would not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites.

The life stages of aquatic life and other wildlife would not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic and economic values would not occur.

e. On the basis of the guidelines, the proposed sites for the discharge of fill materials are specified as complying with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the aquatic ecosystem.

DATE: 9 Sept. 1986

for [signature], LTC
C. HILTON DUNN, JR.
Colonel, CE
District Engineer

United States Department of the Interior
FISH AND WILDLIFE SERVICE
P.O. Drawer 1190
Daphne, AL 36526

September 16, 1986

Colonel C. Hilton Dunn
District Engineer
U.S. Army Corps of Engineers
P.O. Box 2288
Mobile, Alabama 36628

Dear Colonel Dunn:

In accordance with the Letter of Agreement between our agencies for Fiscal Year 1986, the Fish and Wildlife Service has completed this revised Fish and Wildlife Coordination Act Report relative to the Upper Gordons Creek Flood Control Study in Hattiesburg, Mississippi. The report provides an assessment of the effects the selected alternative will have upon fish and wildlife resources, identifies design criteria to minimize resource losses, and outlines mitigative features that would offset unavoidable resource losses. Our report has been prepared under the authority of, and is submitted in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. et seq.). This document constitutes a final report within the meaning of Section 2(b) of the Coordination Act.

Sincerely,

Larry E. Goldman
Field Supervisor

FISH AND WILDLIFE COORDINATION ACT REPORT

UPPER GORDONS CREEK

FLOOD CONTROL PROJECT

Submitted to
Mobile District
U.S. Army Corps of Engineers
Mobile, Alabama

Prepared by
U.S. Fish and Wildlife Service
Division of Ecological Services
Daphne, Alabama

September 1986

Previous Flood Control Measures

In 1947, 1957, and 1961 major flooding occurred in the Leaf River watershed with the rapidly rising waters on Gordons Creek causing substantial damage to the city of Hattiesburg. In response to these floods, the Corps of Engineers (COE) was directed by Congress to study flood control measures along Gordons Creek, and in 1979 constructed a Section 205 project on the lower 2.35 miles of the stream. The project, which is presently being operated and maintained by the local sponsor, Pat Harrison Waterway District, consists of clearing and snagging of the stream from the mouth to Bay Street (1.11 miles), and channel widening with a 40-foot bottom width from Bay Street to Broad Street (1.24 miles). It is the responsibility of the local sponsor to periodically inspect the project area, clearing the channel of debris, removing shrubs and trees from cleared areas, controlling bank erosion, maintaining riprap sections, and maintaining grassed areas.

Present Flood Control Planning

Since the existing project was completed in 1979, urban development has dramatically increased along Gordons Creek, particularly along the upper 3.0 miles of the stream (See Figure 1). This development, consisting of automobile dealerships, fast food restaurants, motels, businesses, and residential subdivisions, has occurred within the 100 year floodplain and for the most part well within the designated floodway as defined by the National Flood Insurance Program (NFIP). Although the city of Hattiesburg is an active participant in the regular phase of the NFIP, there appears to have been little regard to the enforcement of floodplain management regulations along upper Gordons Creek.

It was only a matter of time before the area again experienced high amounts of rainfall causing Gordons Creek to rise and abandon its channel. On April 6, 1983, approximately 14 inches of rain fell within the vicinity, resulting in severe flash flooding and substantial flood damage to the city of Hattiesburg, particularly along upper Gordons Creek. Flood damage estimates reached as high as $40.0 million in Forrest county with a high percentage of this amount being attributed to the residential and business development along upper Gordons Creek. The FWS, along with other agencies, participated on the Flood Emergency Management Agency (FEMA) Interagency Hazard Mitigation Team (HMT) to investigate measures that could prevent such a disaster from occurring again and/or minimize the extent of future flood induced damages.

The HMT prepared a working report (dated April 21, 1983) that placed special emphasis on nonstructural flood control measures including:

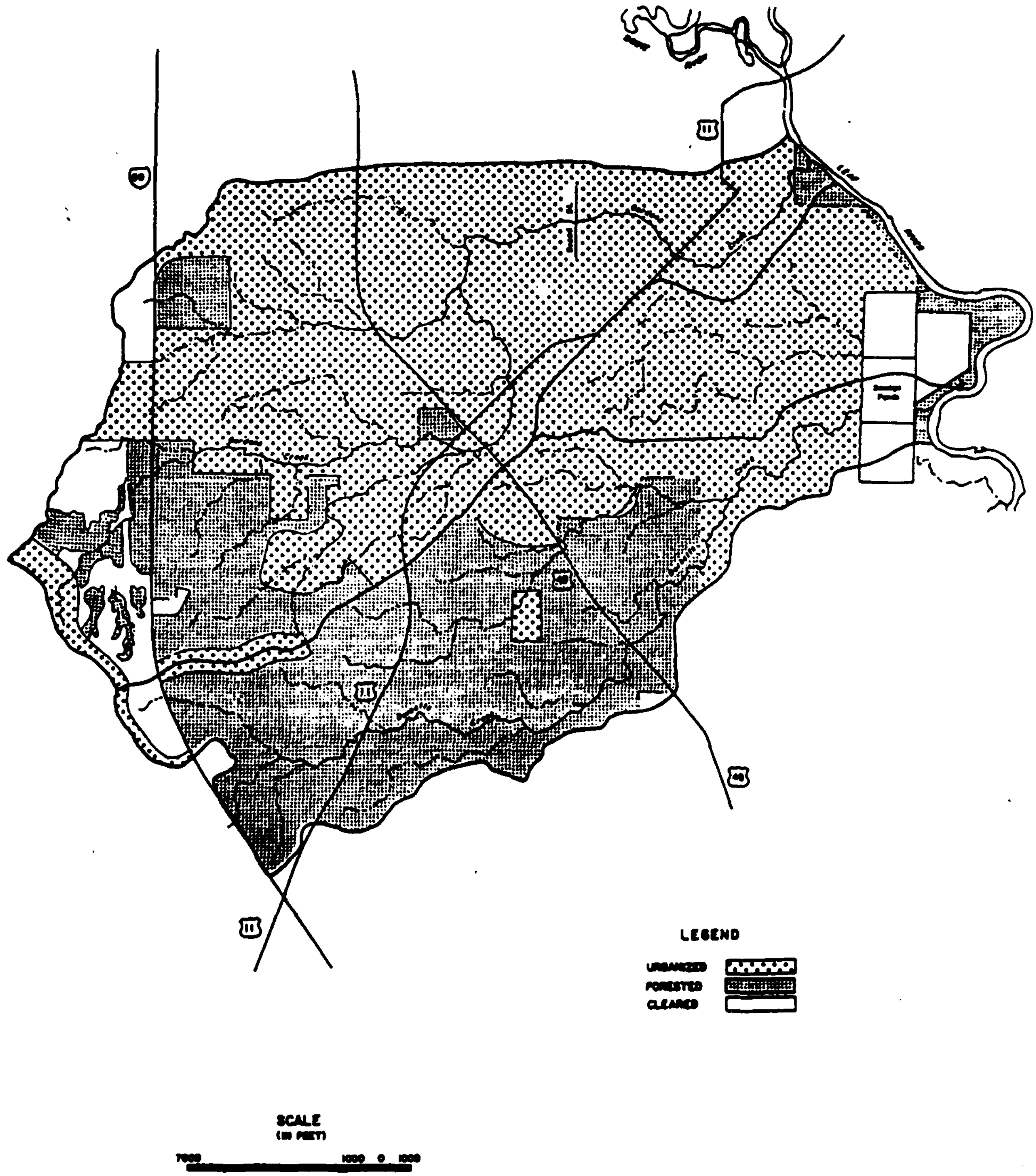


Figure 1

LAND USE MAP

GORDONS CREEK
DRAINAGE BASIN

1) continuing to promote the importance of flash flood awareness and response to appropriate State and local entities and to the public;

2) encouraging locals to adopt and imolement appropriate design criteria for drainage facilities;

3) encouraging the enforcement of floodplain management regulations already in place and requesting that FEMA conduct a Community Assistance & Program Evaluation in the city of Hattiesburg;

4) encouraging the continued removal of structures and relocation of residents from the most severely flooded areas.

In response to the recent flooding and associated damages, the COE initiated this Section 205 flood control planning effort. Through engineering and economic analyses, the COE has developed a final array of alternatives. Table 1 is a summary of the major components of the final array of alternatives developed by the COE through engineering and economic analysis. Figures 2-7 display the respective alternatives.

Selected Alternative

The COE has selected Plan 27, the National Economic Development Plan, for construction. Figure 7 is a graphic display of the selected alternative. As summarized in Table 1, Plan 27 consists of the construction of a 40-foot bottom width channel from the upstream terminus of the previously constructed project, Broad Street, upstream to Hardy Street where it would connect to an existing concrete lined stream segment (Figure 7). Nine residences would be evacuated in the vicinity of Brooklane Street. A 30-foot bottom width channel would be constructed from U.S. Highway 11 (Broadway Drive), upstream to 28th Avenue. At 28th Avenue, the channel would transition to 20-foot bottom width and continue upstream about one mile to 40th Avenue. Channel sides would be constructed to a 1 vertical to 3 horizontal slope and there would be a 15-foot construction right-of-way along both bank tops. Riprap would be used to armor various curves and bridge crossings.

Table 1. Final array of flood control alternatives for Upper Gordons Creek, Hattiesburg, Mississippi

Measure	Work	Size	Location	Stream Length	Cost
23	Channelization	40 ft.	Broad St. to 28th. Ave.	3.6 mi.	$ 4,985,900
24	Channelization	40 ft.	Broad St to 28th. Ave.	4.6 mi.	$ 7,209,400
	Channelization	30 ft.	28th Ave. to 40th Ave.		
26	Channelization	40 ft.	Broad St. to Hardy St.		
	Channelization	40 ft.	Camp St. to 28th Ave.		
	Channelization	30 ft.	28 Ave. to 40th Ave.		
	Channelization	30 ft.	*Camp St. to U.S. 49		
	Channelization	20 ft.	*U.S. 49 to 34th Ave	5.3 mi.	$10,329,900
32	Evacuation	**	10-year floodplain	**	$ 1,426,900
24B	Channelization	40 ft.	Broad St. to Hardy St.		
	Channelization	30 ft.	Camp St. to 28th Ave.		
	Channelization	20 ft.	28th. Ave. to 40th Ave.	4.6 mi.	$ 7,940,500
27	Channelization	40 ft.	Broad St. to Hardy St.		
	Evacuation	**	Vicinity of Brooklane St.		
	Channelization	30 ft.	U.S. 11 to 28th Ave.		
	Channelization	20 ft.	28th Ave. to 40th Ave.	3.8 mi.	$ 6,619,000

* Proposed work on Tributary 1 (Figure 4)
** Not applicable

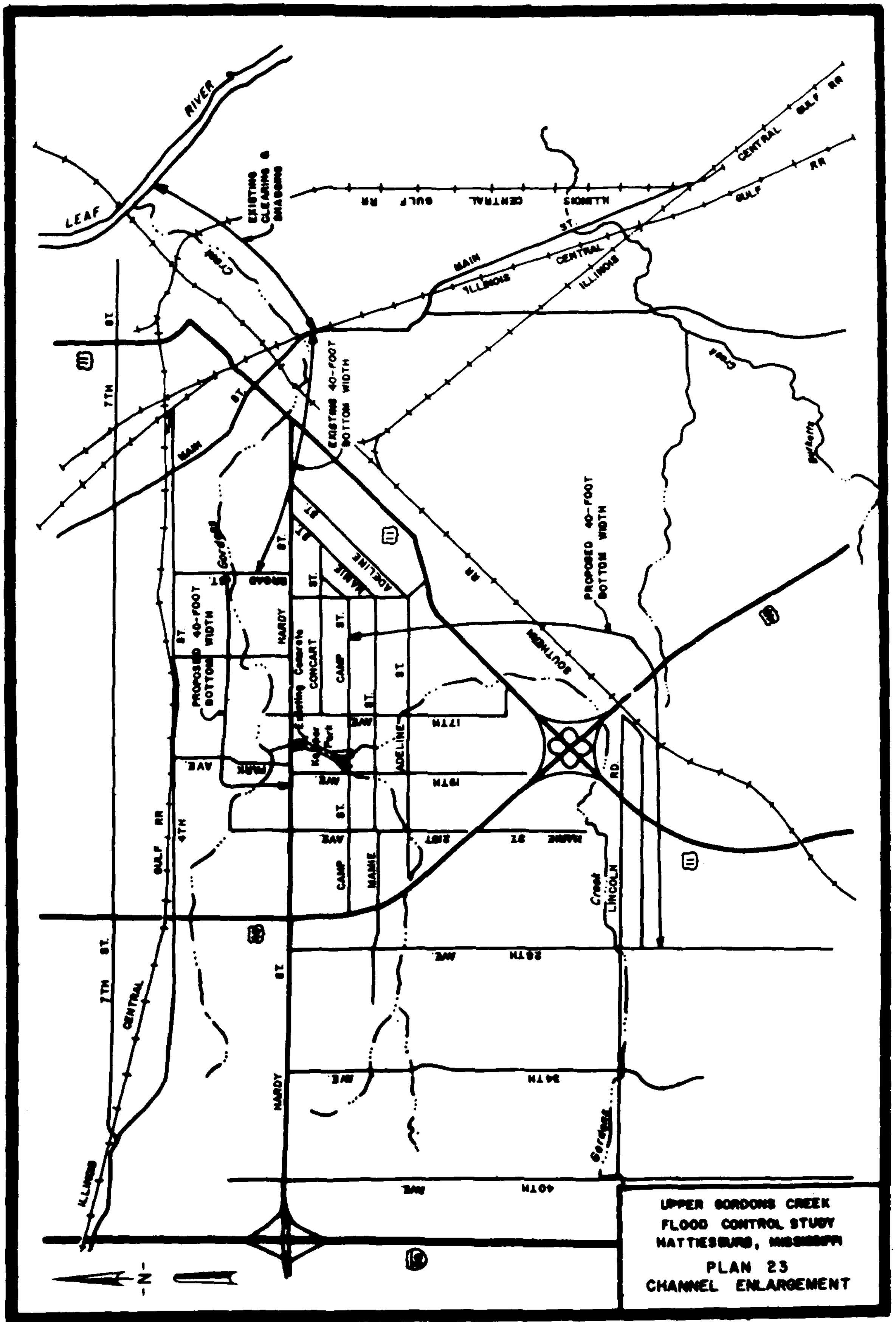

UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
PLAN 23
CHANNEL ENLARGEMENT
LEAF
RIVER

Figure 2

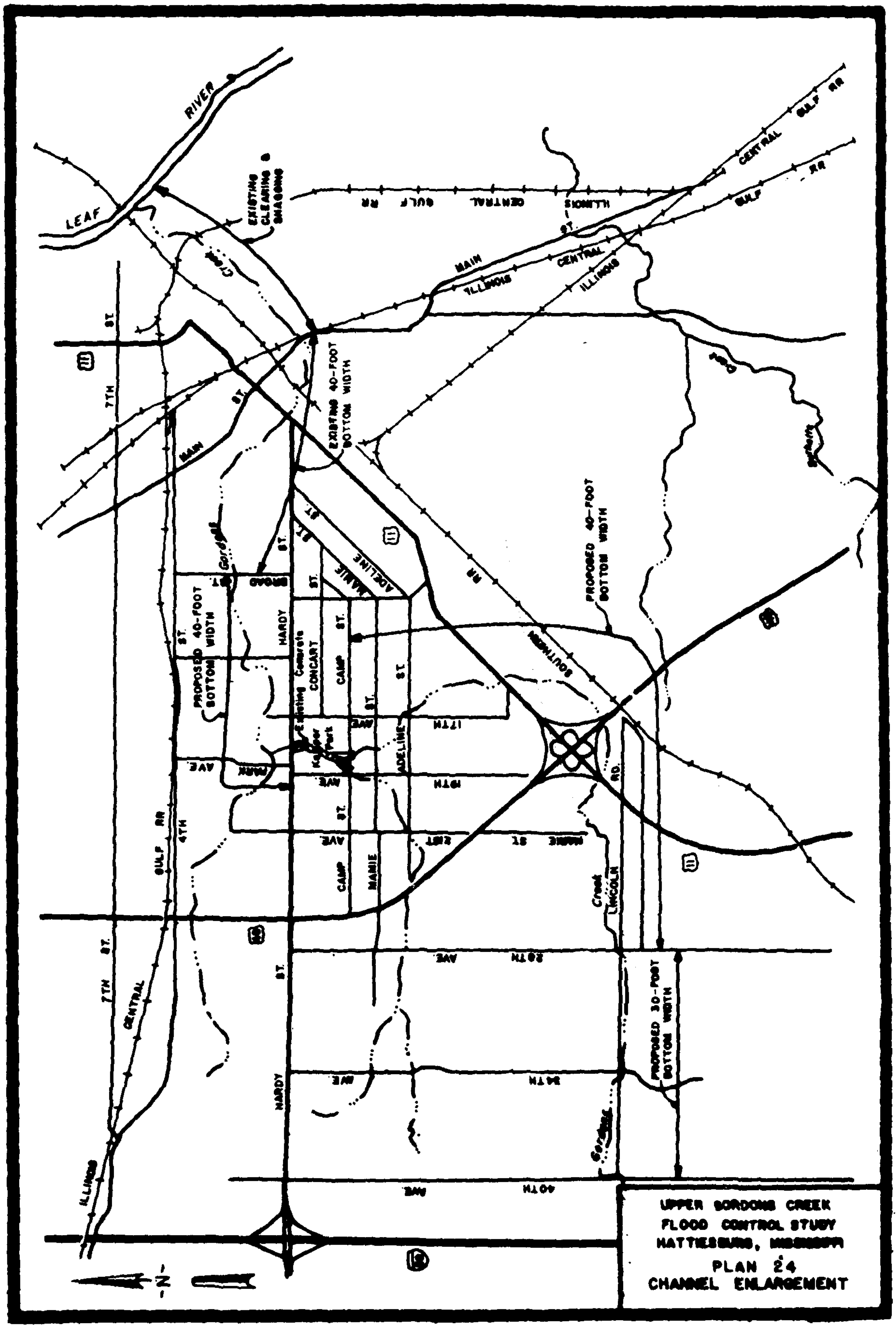

UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG,
PLAN 24
CHANNEL ENLARGEMENT
LEAF
RIVER
EXISTING CLEARING & SNAGGING
EXISTING 40-FOOT BOTTOM WIDTH
PROPOSED 40-FOOT BOTTOM WIDTH
PROPOSED 30-FOOT BOTTOM WIDTH
N

Figure 3

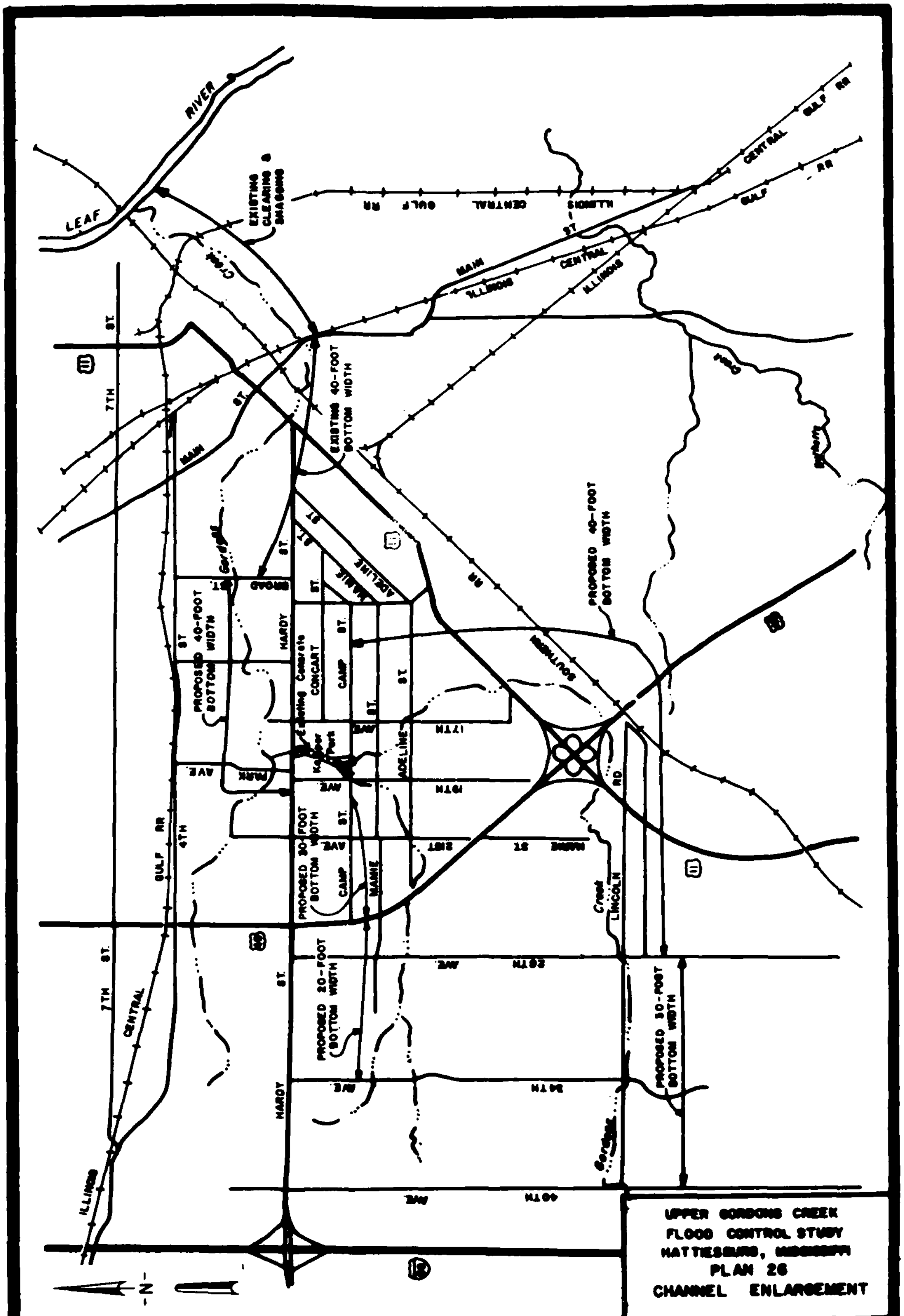

UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
PLAN 26
CHANNEL ENLARGEMENT

Figure 4

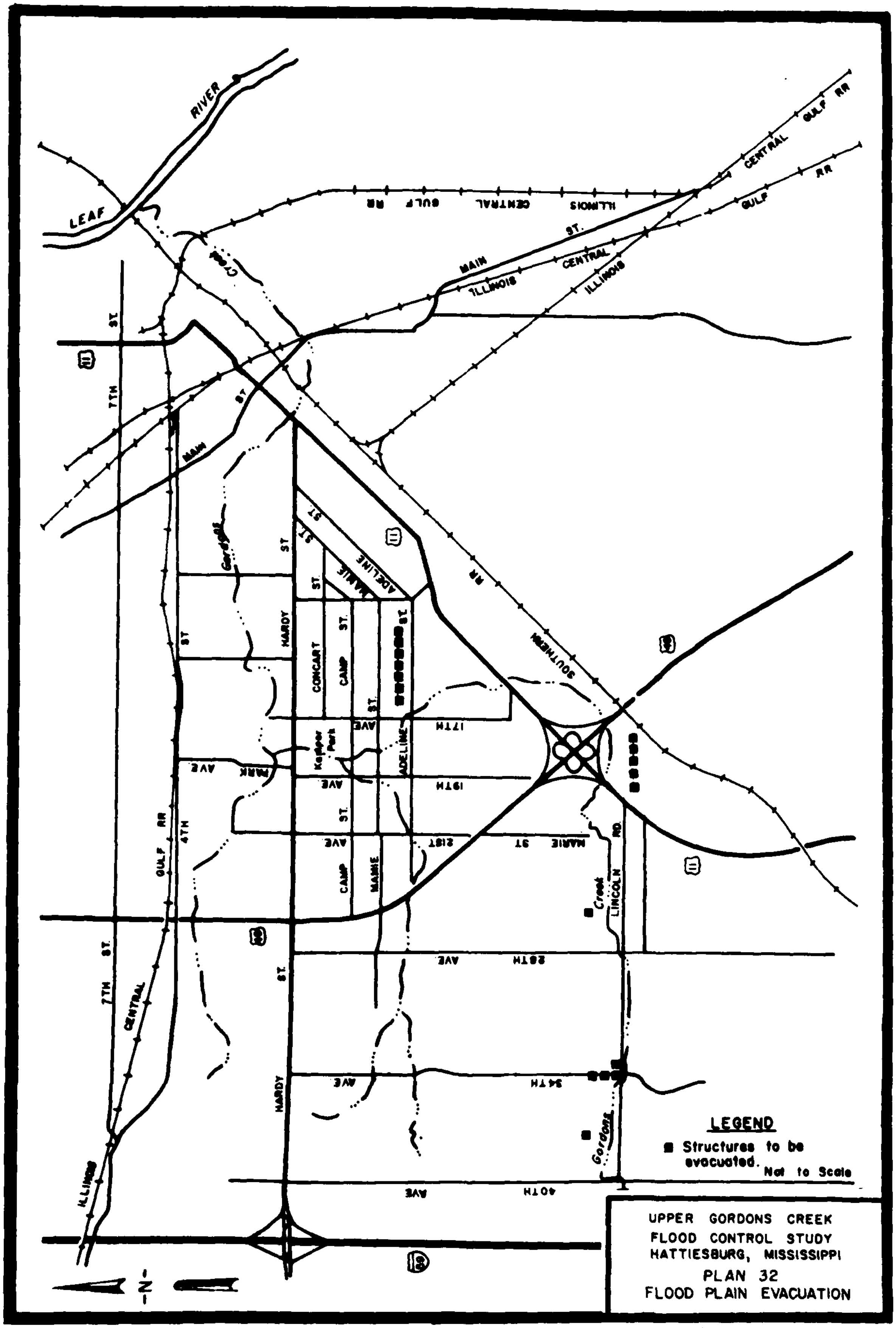

LEAF RIVER
ILLINOIS CENTRAL GULF RR
MAIN ST.
7TH ST.
4TH ST.
HARDY ST.
CONCART
CAMP ST.
MAMIE ST.
ADELINE ST.
17TH AVE
19TH AVE
21ST AVE
28TH AVE
34TH AVE
40TH AVE
PARK AVE
Kamper Park
SOUTHERN RR
LINCOLN RD.
Gordons Creek
LEGEND
Structures to be evacuated.
Not to Scale
N
UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
PLAN 32
FLOOD PLAIN EVACUATION

Figure 5

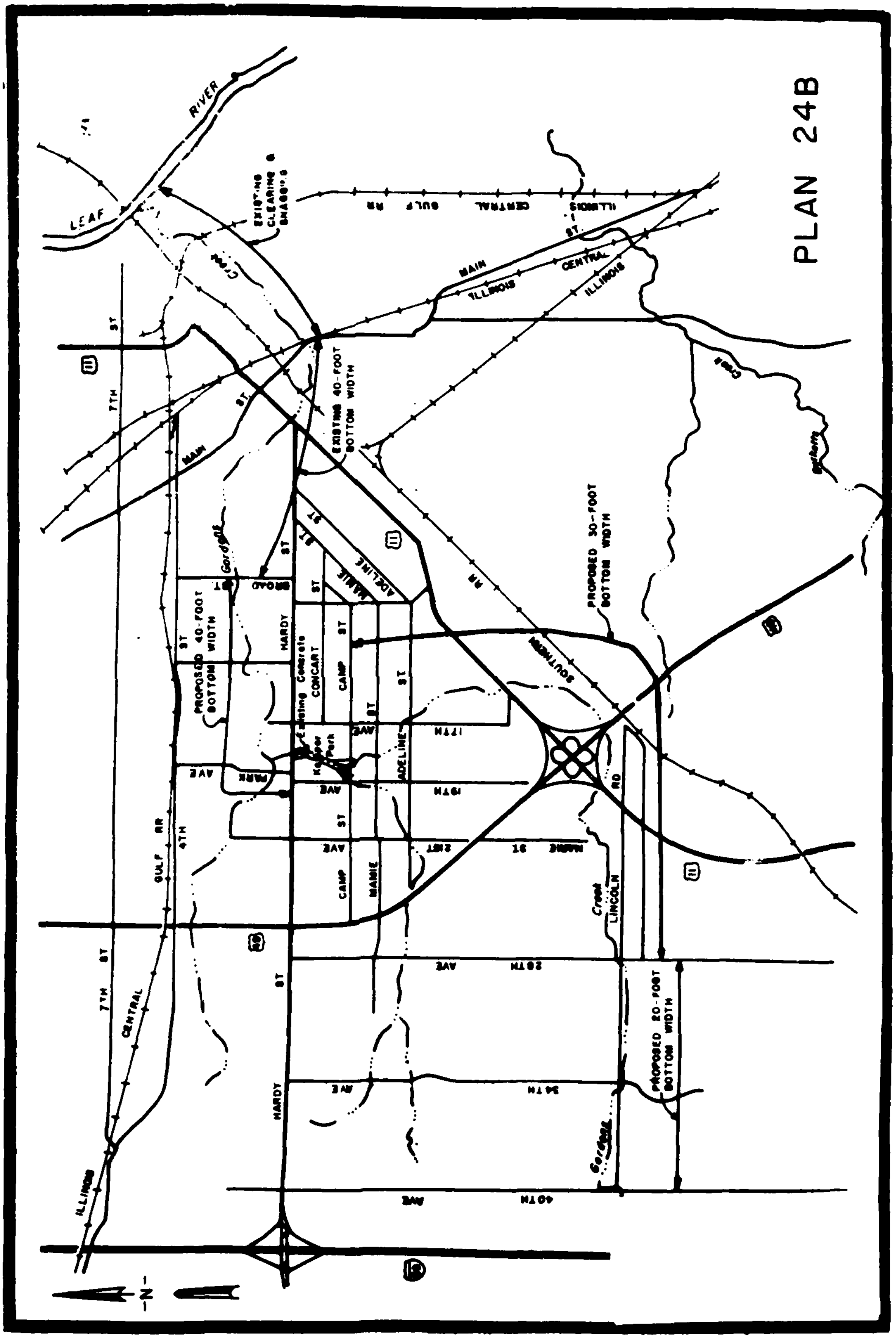

PLAN 24B
LEAF
RIVER
EXISTING CLEARING & SNAGGING
ILLINOIS CENTRAL GULF RR
MAIN ST
ILLINOIS CENTRAL
EXISTING 40-FOOT BOTTOM WIDTH
PROPOSED 30-FOOT BOTTOM WIDTH
PROPOSED 40-FOOT BOTTOM WIDTH
PROPOSED 20-FOOT BOTTOM WIDTH
7TH ST
BROAD ST
HARDY ST
ADELINE
MAMIE
CONCART
CAMP ST
Existing Concrete
Kamper Park
PARK AVE
17TH AVE
19TH AVE
21ST AVE
28TH AVE
34TH AVE
40TH AVE
SOUTHERN RR
LINCOLN RD
Gordons Creek
GULF RR
4TH
N

Figure 6

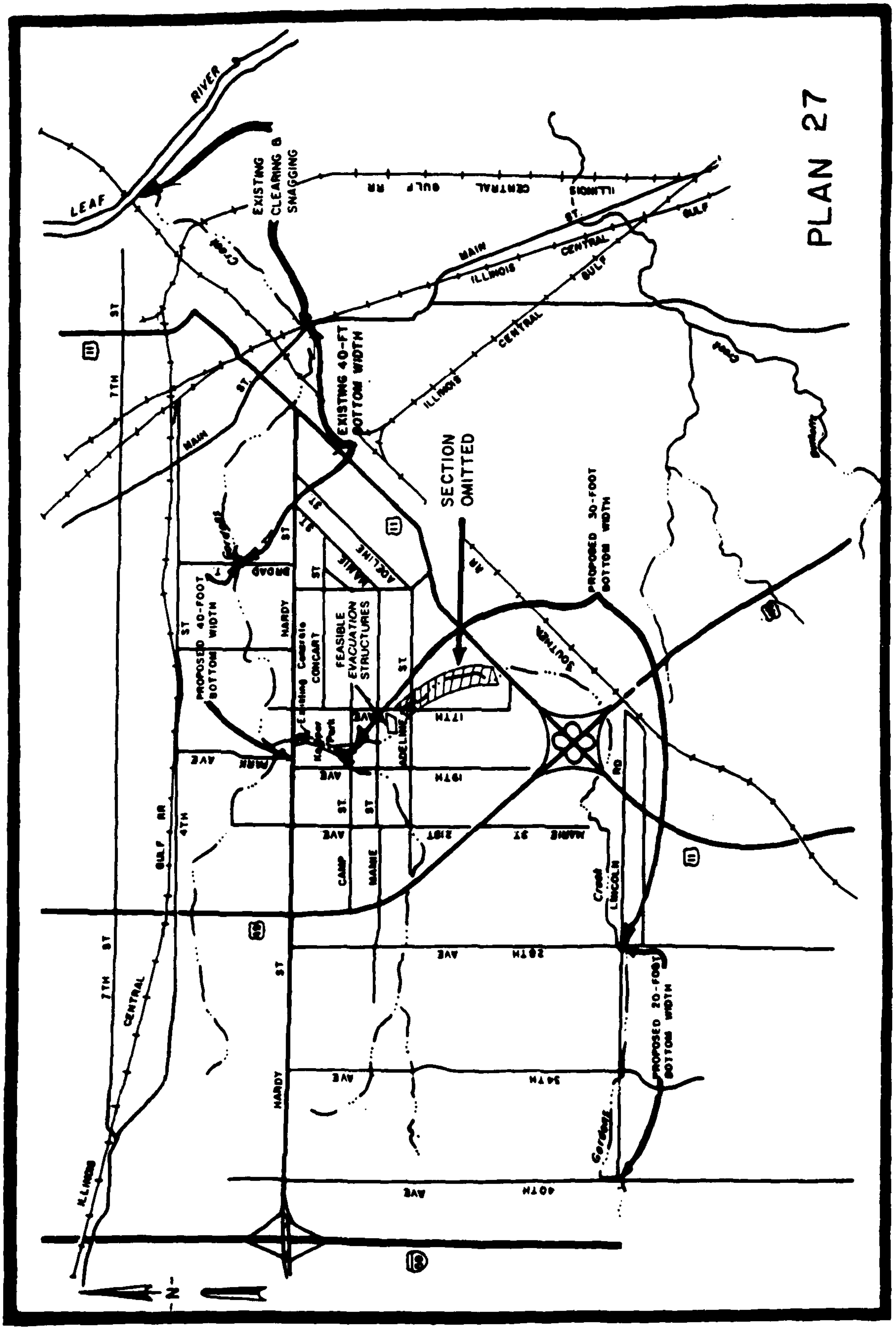

PLAN 27
LEAF RIVER
EXISTING CLEARING & SNAGGING
EXISTING 40-FT BOTTOM WIDTH
SECTION OMITTED
PROPOSED 30-FOOT BOTTOM WIDTH
PROPOSED 40-FOOT BOTTOM WIDTH
FEASIBLE EVACUATION STRUCTURES
PROPOSED 20-FOOT BOTTOM WIDTH

Figure 7

AREA DESCRIPTION

Gordons Creek is a small, highly urbanized stream which empties into the Leaf River in Forrest County approximately 0.5 miles downstream of the confluence of the Leaf and Bowie Rivers. The stream has a drainage area of approximately 10 square miles and is about 8.0 miles in total length. The headwaters of Gordons Creek originate around the Lamar-Forrest County line and are classified by the U.S. Geological Survey (USGS, 1964) as intermittent.

Urban development, as shown in Figure 1, is the dominant land use in the Gordons Creek watershed. One exception is an approximately 1,000 acre tract of pine and mixed pine-hardwoods in the southwestern drainage limits. The primary type of development throughout most of the drainage basin is residential with the exception of business and municipal development immediately downtown, and near the U.S. 11 and U.S. 49 bridge crossings. The most drastic land use change within the last ten years has been the rapid residential development west of U.S. 49. The area, known locally as the Lincoln Road extension, was primarily forested floodplain in 1964. However, practically the entire floodplain is developed with residences.

Future land use predictions indicate that the Hattiesburg area will continue to experience growth. According to the city of Hattiesburg and the Lamar County Planning Commission, the remaining undeveloped portions of the Gordons Creek drainage are projected to be converted to residential land uses by the year 2000.

Aquatic Resources

The fishery resources of the Pascagoula River Basin are highly diverse and are an important resource for sport and commercial interests. Gordons Creek, at one time, undoubtedly supported a relatively diverse and productive fishery. However, habitat quality within the stream today has been significantly altered and the overall value to fisheries has been greatly reduced. Very little water quality data has been collected on Gordons Creek. A short-term intensive water quality study was, however, conducted by the USGS (1973) on October 18, 1973. The results of this investigation, although certainly not indicative of the year-round stream condition, indicate that relatively high levels of ammonia nitrogen (1.3 mg/l), total phosphorous (0.76 mg/l), and fecal coliform (14,000 col/100ml) were present in the stream. Although these parameters were somewhat elevated, they are fairly indicative of an urbanized stream.

In conjunction with a historical decline in water quality, instream aquatic habitat conditions have been significantly altered by several structural activities. The most degrading habitat alteration, aside from water quality, appears to have been associated with attempts to control flood waters. Channel enlargement, clearing and snagging,

bank stabilization, concrete liners, and diversions have significantly altered the quality and diversity of available habitat for fisheries.

Although Gordons Creek is heavily urbanized, it probably continues to provide feeding, resting and reproductive habitat for some fish species in the lower reaches. A recent fishery investigation was conducted by Boschung and Schiering (1981) on the Leaf and Bowie Rivers near Hattiesburg. In this study, 46 species representing 26 genera and 11 families were collected. Of these, four species represented over 67 percent of the total fish collected: silverjaw minnow (Ericymba buccata), longnose shiner (Notropis lonigrostris), blacktail shiner (N. venustus), and longear sunfish (Lepomis megalotis). Typical game fish collected included bluegill (L. macrochirus), spotted bass (Micropterus punctulatus), and longear sunfish. Many of the smaller fishes, particularly the Cyprinids and juvenile life stages of sport and commercial species, can be found in the lower reaches of Gordons Creek. Little suitable fishery habitat, however, appears to be present upstream of the Main Street bridge crossing in Hattiesburg.

Terrestrial Resources

The Gordons Creek watershed is highly urbanized with continuous development extending from the headwater tributaries to the Leaf River confluence. However, approximately 1,000 acres of pine and mixed pine-hardwood habitats are located in the extreme southwestern portion of the drainage. As mentioned above, this 1,000 acre tract of natural habitat is expected to be completely developed by the year 2000.

On August 16-17, 1983, Fish and Wildlife Service (FWS) biologists conducted field investigations of the lands within the study limits. Although a variety of wildlife habitats can be found along the Leaf River in Hattiesburg, there is very little habitat diversity along Gordons Creek. A narrow fringe of forested wetlands continues to exist in the lower extremities of the stream near its confluence with the Leaf River . Typical vegetative species present in this area include: water oak (Quercus nigra), swamp chestnut oak (Q. michauxii), red maple (Acer rubrum) and black willow (Salix nigra). There is little or no vegetative cover between the Pine Street bridge crossing and the area near the mouth of Gordons Creek. This area is heavily urbanized and only a narrow, intermittent fringe of trees remains, including: American sycamore (Platanus occidentalis), black willow, sweetgum (Liquidambar styraciflua) and a few water oaks. Upstream from this area to the vicinity of U.S. 49 habitat conditions are characteristic of a residential setting. Large, mature water oaks sparsely vegetate the banks of the creek with sweetgum, red maple and black willow also present. Between U.S. 49 and 28th Avenue a small amount of remnant bottomland hardwoods remains.

Species in this area include water oak, red maple, American sycamore, willow oak (Q. phellos) and sweetgum. The area between 28th Avenue and the upper limits of the study area (Lincoln Road extension) has been cleared and little or no vegetative cover is present.

Reduction and degradation of natural habitat have decreased wildlife abundance and diversity in the project area. Species which utilize the remaining habitat include grey squirrel (Sciurus caroliniensis), eastern cottontail (Sylvilagus floridanus), opossum (Didelphis virginiana), raccoon (Procyon lotor), midland banded water snake (Nerodia sipedon pleuralis), Fowlers toad (Bufo woodhousei fowleri), cardinal (Richmondena cardinalis), blue jay (Cyanocitta cristata), Carolina wren (Thryothorus ludovicianus), and numerous other passerine bird species.

Resource Categories

The FWS Mitigation Policy (F.R.46:15) dictates that we assign project area habitats into one of 4 Resource Categories. Each Resource Category is defined with respect to the fish and wildlife productivity of the habitat and its relative abundance on regional and national levels. Each Resource Category also has a defined mitigation goal by which the FWS is guided in seeking mitigation.

Pine, mixed pine-hardwood, and remnant wetlands within the project area are moderately productive for wildlife resources and are relatively abundant nationwide. These habitats have been placed in Resource Category 3. The mitigation goal for Resource Category 3 is no net loss in habitat productivity.

Gordons Creek exhibits low habitat quality for fishery resources due to prior alterations and adjacent urban development. Due to its low productivity and the low productivity of adjacent developed areas for fish and wildlife resources, the FWS has placed these habitats in Resource Category 4. The mitigation goal for Resource Category 4 is to minimize project related impacts to habitat quality.

Endangered Species

The project area lies within the ranges of 7 species listed as endangered and 1 species listed as threatened on the Federal list. The Federal endangered designation means that the species is in danger of extinction throughout its range if population trends apparent at the time of listing continue to occur. The threatened designation indicates the species is vulnerable to becoming endangered due to restricted ranges or low populations.

Both the bald eagle (Haliaeetus leucocephalus) and the Arctic peregrine falcon (Falco peregrinus tundrius) are transitory

residents of the State and may occasionally be sited in the project area. However, significant use of the project area by these species is unlikely.

The project area lies within the historic range of the red wolf (Canis rufus), Florida panther (Felis concolor coryi), and the ivory-billed woodpecker (Campephilos principalis). Unfortunately, both the ivory-billed woodpecker and the red wolf may now be extinct in the wild due to habitat alteration. The Florida panther is now known to be extant only in some areas of Florida.

Ranges of the red-cockaded woodpecker (Picoides borealis) and Bachman's warbler (Vermivora bachmanii) include the project area. However, there appears to be no suitable habitat for these species and they are not expected to be present within the project boundaries.

The study area lies within the endangered American alligator's (Alligator mississippiensis) range. This species utilizes swamps, oxbows, lakes, ponds, and waterways within its range. The alligator may be present within the project area. However, the proposed project is not expected to adversely effect the species or populations within the project area.

The project area also lies within the yellow-blotched sawback turtle's (Graptemyus flavimaculata) range. This species is a candidate for inclusion on the Federal endangered species list. The yellow-blotched sawback is known to inhabit the Leaf River in the vicinity of the project area and may occur in the downstream section of Gordons Creek.

Inclusion of "candidate" species as defined above implies no legal obligation to consider such species. Section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531, et seq.), requires consultation only in regard to actions that may affect listed species or those proposed for listing. There is no responsibility to consult or confer with the FWS regarding "candidate" species. These species are not accorded protection under the Endangered Species Act and are not subject to any of its provisions, including Section 7.

Candidate species are discussed in our reports where it is possible that a formal listing proposal may be made within the next two years, or they could be significantly affected by a single project. This information is provided for the sole purpose of notifying Federal agencies in advance of possible proposals which at some future time may need to be considered in planning Federal activities. If your plans go beyond two years, we recommend that this office be contacted again to determine if there are other candidate species which you may need to be aware of in planning activities.

National Species of Special Emphasis

The FWS has developed a list of National Species of Special Emphasis (NSSE) (F.R.47:176) which includes species and species groups which merit special effort and attention during the planning process due to high biological, legal, and public interest. Species or species groups from the NSSE list which may occur periodically within the study area include: osprey (Pandion haliaetus), bald eagle, arctic peregrine falcon, the heron and allies group, and American alligator. The project is not expected to have any significant adverse impacts to any species of special emphasis.

IMPACT ANALYSIS

As outlined above, the selected plan consists of the construction of a trapazoidal channel of varying bottom widths with 1 vertical to 3 horizontal side slopes. This would include removing instream obstructions, bed load sediments, and bank undercuts, as well as bends where possible.

Removal of debris and obstructions within a stream directly affects the biological community from the very lowest levels upwards to top trophic level consumers. For example, coarse particulate organic matter known as detritus often accumulates around obstructions that reduce stream flow. These organic substrates provide important food sources and cover for diverse macroinvertebrate communities. Once the particulate organic matter is removed, these macroinvertebrates, which are an important source of fish food, are greatly reduced in number or may disappear from the stream altogether. These changes in the basic stream structure and functions can significantly alter ecosystem integrity. Removal of obstructions and the bed load can also indirectly affect macroinvertebrate communities by changing the sediments. Fine sediments such as silts and clays are often eroded if obstructions are removed. These sediments serve as specific substrates for burrowing invertebrates such as the Annelids, Chironomids, and burrowing Ephemeroptids. The loss of these groups can substantially reduce the food resource base for many species of fish.

Fish obviously respond to changes in the nature of their food resources. They also respond to changes in available cover, shelter, and spawning areas. The scientific literature documents that the availability of cover and shelter have distinct influences on fishes in streams. Removal of these areas usually results in a reduction in species inhabiting the area. Fishes also tend to orient themselves in streams to fixed points. In addition, Hynes (1970) noted that many species of fish which are territorial in running water cease to be so when the flow is slowed or stopped. Removal of instream debris and obstructions could noticeably affect the behavior of fishes possibly causing them to leave the area. As with macroinvertebrates, the spawning activity of many fishes is directly related to the character of the sediments. Removal of obstructions, bed load removal, and other sediment alteration could either reduce the reproductive capacity of certain fishes or eliminate them entirely.

Widening the channel and further reducing streamside vegetation is expected to result in increased water temperatures due to decreased shading and increased surface area. Particularly in small streams such as Gordons Creek, water temperature becomes critical during the late summer low flow period. Increased temperature also lowers dissolved oxygen concentrations, putting an additional stress on the aquatic community. Some fish species which cannot tolerate higher

water temperatures than those presently exhibited by Gordons Creek may be extirpated.

For living aquatic resources, channelization is undoubtedly the most devastating measure under consideration for flood control. Previous channel modifications and relocations have greatly contributed to the present degraded condition of Gordons Creek. Adverse impacts associated with the proposed project would be somewhat diminished by the fact that present instream habitat conditions are limited. This is not to say that there would be no adverse impacts associated with channelizing Gordons Creek, but rather that it would further degrade an already stressed resource.

The loss of riparian trees and other vegetation associated with channel widening would be detrimental to wildlife resources within the project area. The riparian woodlands provide cover, travel lanes, feeding and nesting areas for an array of urban wildlife. Along Gordons Creek, the riparian fringe has been practically eliminated with the exception of a few areas which constitute the majority of the remaining woodland in the project area. A number of birds, mammals, reptiles, and amphibians are dependent upon this habitat. Loss of these areas would greatly reduce wildlife populations in the project area.

DISCUSSION

The most effective way to reduce impacts associated with channelization would be to utilize a less damaging alternative. In this case, the COE has retained an evacuation plan for the 10-year floodplain in the final array of alternatives. COE data indicates that evacuation of the 10-year floodplain would cost less than a fourth of what the selected alternative costs. Floodplain evacuation has a benefit to cost ratio of 1.5 to 1. Floodplain evacuation would eliminate flood damages within the evacuated area while channelization only reduces the frequency of flooding, allowing damages to occur less frequently. Given currently exhibited development trends in the project area, future flood damages are likely to increase due to floodplain development spurred by channelization. Adoption of mandatory ordinances prohibiting flood sensitive development within the evacuated area, on the other hand, would serve to prevent future increased flood damages. In addition, fish and wildlife resources would benefit from floodplain evacuation if the evacuated areas were allowed to revegetate and provide a riparian buffer along the creek.

The selected plan (Figure 7) consists of channelizing the majority of Gordons Creek in the project area. Previous channel modifications and relocations have degraded Gordons Creek aquatic resources. Implementation of the selected plan would further degrade instream habitat quality, placing additional stresses on the remaining fishery resources.

The major impacts to wildlife associated with the selected plan would be the loss of 19.6 acres of riparian trees along the stream. This fragmented habitat is in most cases the only remaining natural areas for wildlife within the project area. As a result of FWS-COE coordination efforts, some mitigative features have been incorporated into the proposed plan which would greatly reduce impacts to wildlife resources. There would be no clearing in the 15-foot wide rights-of-way along both banks of the project. This measure would reduce project clearing by 5.6 acres. In addition, the rights-of-way would be widened from 15 feet to 30 feet where possible and no clearing of trees would be allowed within the rights-of-way. A total of 18 acres would be included in the extended right-of-way. Portions of this 18 acre right-of-way that are not now forested would be planted with trees and other plantings for wildlife. Mast producing tree species including water oak, laurel oak, and willow oak should be planted due to their high productivity for urban wildlife. The trees should be planted in a 10 ft. by 10 ft. matrix.

We believe that establishing and maintaining a protected riparian buffer zone along Gordon's Creek would offset the impacts to wildlife caused by other project clearing. As the newly planted trees mature, they should provide habitat for wildlife suited for urban areas. In

addition, the trees will provide an increasing amount of shading of the stream, thereby benefiting aquatic resources. The riparian buffer would also enhance water quality in the stream by trapping pollutants from surface runoff and stabilizing the streambanks, thereby reducing erosion.

CONCLUSIONS AND RECOMMENDATIONS

In conclusion, it is the belief of the FWS that substantial impacts to fish and wildlife resources could be avoided by selecting the evacuation plan. We, therefore, strongly recommend the evacuation plan for implementation because it is the most efficient and effective plan in terms of project purposes, it preserves and enhances fish and wildlife resources, and it will cost the public considerably less than the selected plan.

In the event that the Congress authorizes the selected plan, a number of modifications would have to be incorporated to reduce impacts from a fish and wildlife standpoint. The FWS recommends that the following mitigative features be incorporated into the selected plan in order to conserve fish and wildlife resources:

1. All clearing should be limited to the construction limits of the channel. No clearing should be done in the project rights-of-way;

2. Rights-of-way for the project should be extended to 30 feet wide, where possible, to include a minimum of 18 acres;

3. Unforested portions of the 18 acre rights-of-way should be planted with trees to benefit urban wildlife as specified in this report; and

4. A protected riparian buffer be maintained on the rights-of-way following project construction for the project life. All cutting of trees within the protected buffer would be prohibited except for removal of those trees which may fall into the stream.

LITERATURE CITED

Boschung, Herbert T. and Joseph F. Scheiring. 1981. A Study of the Macroinvertebrates and Fishes of the Bowie and Leaf Rivers in the Area of Hattiesburg, Mississippi. USA/COE Contract No. DACW01-81-M-A104.

Hynes, H.B.N. 1970. The Ecology of Running Waters. University of Toronto Press:Toronto.

U.S.G.S. 1964. Hattiesburg, Mississippi: 7.5 minute quadrangle (Topographic) map. U.S.G.S.:Washington.

U.S.G.S. 1973. A Study of the Surface Water Quality in the Hattiesburg, Mississippi Area: October 1973. Open File Report 76-401.

APPENDIX 5

COORDINATION

APPENDIX 5
PUBLIC INVOLVEMENT AND COORDINATION

TABLE OF CONTENTS

TELEPHONE (601) 584-8431 ZIP CODE 39401

THE CITY OF HATTIESBURG, MISSISSIPPI

October 1, 1980

Col. Robert H. Ryan
District Engineer
U. S. Army Corps of Engineers
P. O. Box 2288
Mobile, Alabama 36628

Re: Additions to Gordon's Creek Flash Flood Project

Dear Col. Ryan,

As you are aware the Corps of Engineers has recently completed a flash flood relief project along a section of Gordon's Creek here in our city. This project is providing numerous benefits to our residents in and adjacent to the project area.

It is my understanding that the Corps programmed as much of this project as was economically feasible. However, as a result of increased run-off from new construction and the addition of several homes that are being affected, it is my belief, that additional segment(s) could be economically feasible.

For this reason, I would appreciate your doing a reconnaissance survey along the Gordon's Creek to determine the feasibility of extending the project.

Your cooperation and assistance is both needed and appreciated.

Sincerely yours,

G. D. Williamson

G. D. Williamson
Commissioner

GDW/HDP/eb

cc: Mayor Bobby L. Chain
Congressman Trent Lott
Senator John C. Stennis 5-1
Senator Thad Cochran

PAT HARRISON WATERWAY DISTRICT

P O DRAWER 1509
HATTIESBURG, MISSISSIPPI 39401
TELEPHONE 264-5951

A. L. "BUD" GERRARD, JR.—EXECUTIVE DIRECTOR

July 25, 1986

Colonel C. Hilton Dunn, Jr.
District Engineer, Mobile
U. S. Army Corps of Engineers
Post Office Box 2288
Mobile, Alabama 36628-0001

Dear Colonel Dunn:

Attached please find a letter and minute order from the City of Hattiesburg wherein they have basically endorsed the Upper Gordon's Creek plan as presented by Mr. Bill Reid of your office.

Additionally, Hattiesburg has requested Pat Harrison Waterway District to act as the local sponsor for the project. The Board of Directors of Pat Harrison Waterway District at its regularly scheduled meeting of July 24, 1986, has authorized Pat Harrison Waterway District to be the sponsor for the project.

I am requesting that you continue your efforts to develop the plan, to include plans and specifications, as presented by Mr. Reid. When the time comes to implement the project, Hattiesburg is requesting that you cause the project to be constructed in two phases as exemplified thereby.

Sincerely,

A. L. Gerrard, Jr.
Executive Director

ALG:jw

Attachment

cc: City of Hattiesburg
Congressman Trent Lott
James Barr
Sandy Sanford

"Industrial Growth Through Waterway Development and Flood Control"

KATHRYN CUMMINGS
Ward 1

EDDIE HOLLOWAY
Vice President
Ward 2

City Of Hattiesburg

G. D. WILLIAMSON
MAYOR

ED MORGAN, Council President
Ward 4

JOHN BUCKLEY
Ward 3

CHARLES LAWRENCE, JR.
Ward 5

July 23, 1986

Pat Harrison Waterway District
311 South 26th Avenue
Hattiesburg, Mississippi 39401

Dear Sirs:

On July 22, 1986, the Hattiesburg City Council authorized Mayor G.D. Williamson to request the Pat Harrison Waterway District to act as sponsor for the Gordon's Creek Project to the Corp. of Engineers.

In addition, the Council has given the Mayor the authority to ask that the project be implemented in two phases - Phase 1 being that portion from Broad Street upstream to U.S. Highway 11 and Phase 2 being that portion from U.S. Highway 11 to 40th Avenue.

Enclosed you will find a certified copy of the Minute Order authorizing these actions. If you require any further information, please call Council President Ed Morgan at 583-3566 or Public Services Director Herlon Pierce at 545-4540.

Thank you in advance for your cooperation.

Sincerely yours,

G.D. Williamson

G.D. Williamson
Mayor of Hattiesburg

Ed Morgan

Ed Morgan
Council President

GDW/EM:sa

Enclosure

P.O. BOX 1898 • Hattiesburg, MS 39401

STATE OF MISSISSIPPI)

COUNTY OF FORREST)

I, Clarice Wansley, City Clerk of the City of Hattiesburg, Mississippi, do hereby certify that the foregoing is a true and correct copy of an Order adopted by the City Council of said City at the regular meeting held on July 22, 1986.

WITNESS my signature and the official seal of said City on this, the 23rd day of July, A.D., 1986.

Clarice Wansley
CITY CLERK

(S E A L)

MOTION was made by Councilman Buckley and seconded by Councilman Lawrence to approve authorization for the Mayor to request the Pat Harrison Waterway District to act as sponsor to the Corp of Engineers for the Gordon's Creek flash flooding improvements, and approve authorization for the Mayor to request that the project be in two phases - Phase 1 being that portion from Broad Street to U.S. Highway 11 and Phase 2 being that portion from U.S. Highway 11 to 40th Avenue.

Following discussion, the motion received the affirmative vote of the Council as follows:

YEAS: Cummings Holloway Buckley Morgan Lawrence	NAYS: None

This being the 22nd day of July, A.D., 1986.

ANNOUNCEMENT
OF
PUBLIC MEETING
ON
FLOOD CONTROL
FOR
UPPER GORDONS CREEK
AT
HATTIESBURG, MISSISSIPPI

THE MEETING WILL BE HELD

on

THURSDAY, OCTOBER 28, 1982

at

7:00 PM

at

CITY COMMUNITY CENTER
222 FRONT STREET
HATTIESBURG, MISSISSIPPI

THIS IS YOUR INVITATION

The Mobile District of the Corps of Engineers is beginning a detailed study of the flooding problems along Upper Gordons Creek at Hattiesburg, Mississippi, to determine the need for flood protection. Before we can begin to study, we need to know your impressions on the stream's flood and other problems and what, if anything, is needed to solve the problems. You are invited to meet with us to express your views.

HOW DO YOU FEEL ABOUT THE STREAM?

Should it be altered or should it remain in its present state? How often does it flood? How much damage does it do? Is it scenic? Are there any fish in it? What kind? These are a few of the types of questions that we are looking to you to help us answer.

WHY STUDY THE CREEK?

Upper Gordons Creek has had history of flooding which we feel should be studied. This study will examine the flood problem and investigate measures to alleviate the flood problem and consequent damages. Factors to be considered are the seriousness of the flood problem; the environmental consequences of various solutions to the problem; the social effects of both doing and not doing something about the problem; and the desires of the people.

WHAT IS THE AUTHORITY FOR THIS STUDY?

The Congress of the United States has provided authority for the Corps of Engineers to plan, design, and construct small flood control projects that have not been specifically authorized by Congress. This avoids any possible delays while awaiting Congressional action on a particular project. This authority was first provided in Section 205 of the Flood Control Act of 1948, and has been amended so that up to $4 million can be spent to solve a flooding problem in a locality. In October 1980 Commissioner G. D. Williamson requested that the Corps of Engineers undertake this study. A reconnaissance study was completed in February 1982 which indicated the need for this detailed study.

WHAT WILL BE STUDIED?

Right now we are collecting facts so that we will have a full understanding of the problem. We need to know what lands and development are flooded and how many people are affected. We need to know about the creek's present wildlife resource: the fish, animals, and plants that live along the stream. And we need to know about anything else that is or could be affected by the creek or what happens to it. The information you can provide us at this meeting is most needed.

Once the existing condition of the creek and the affected area has been established, we will look at ways to solve the flood problem. We will look at all reasonable plans from leaving the stream in its natural state to major constructions.

We will look into the effects of each of these plans. How much would they cost? What would their benefits be? How will they affect the people? What would they do to the environment? All of these questions will be answered.

The next step will then be to decide which of these plans should be looked at closer and which ones should be dropped from further consideration. We will very carefully study the ones that remain, looking at every detail of each plan and its effect before any decision is made.

HOW LONG WILL ALL THIS TAKE?

Following this procedure, we should complete our studies and make our recommendations to the South Atlantic Division Engineer in Atlanta in the summer of 1984.

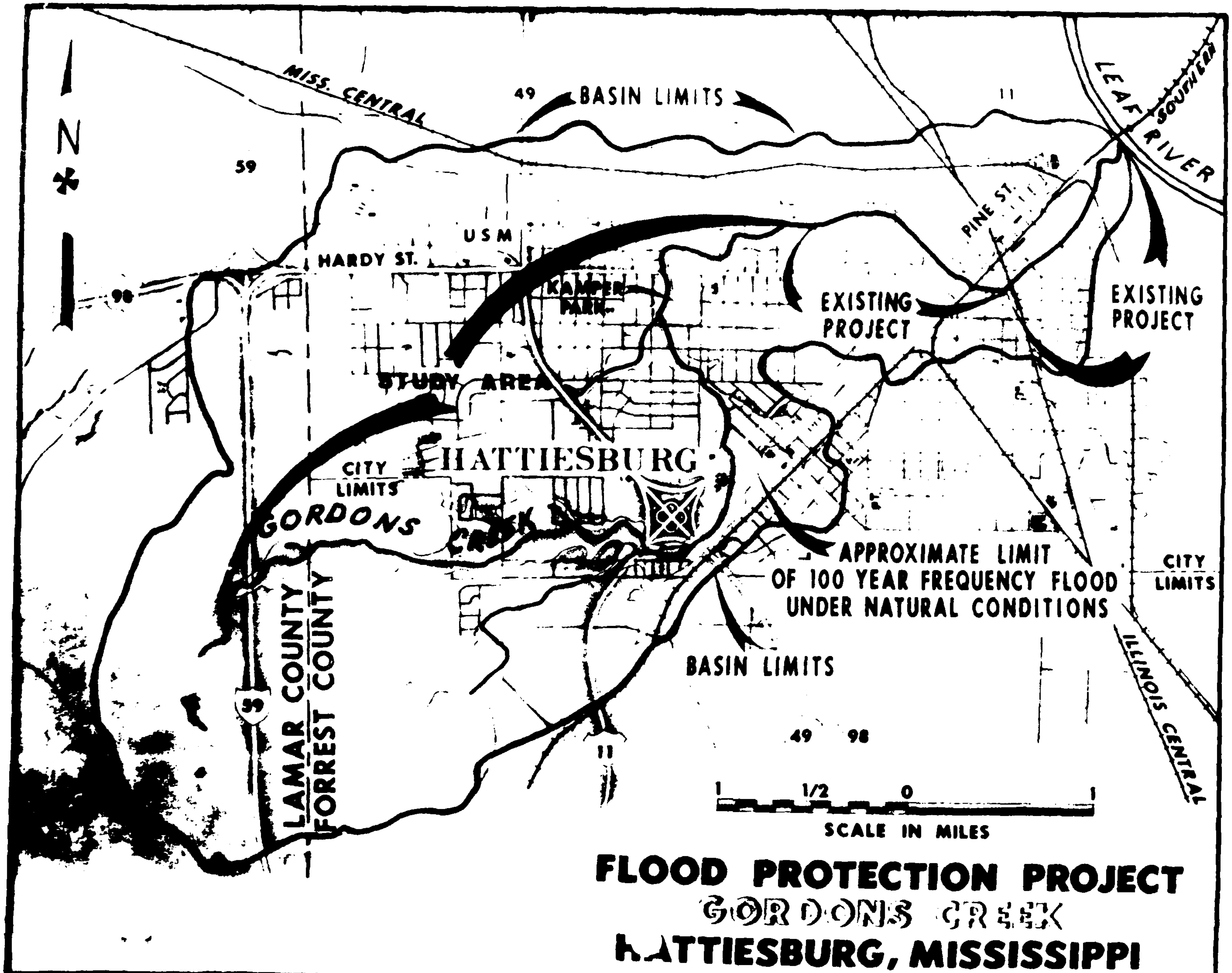
WHY HAVE THIS MEETING?

The purpose of this meeting is to find out how you feel about this creek and the problems it causes. Everyone is invited and urged to be present or represented, and will be given an opportunity to express their views. Oral statements will be heard, but for accuracy of the record, all important facts and comments should be submitted in writing. Written statements may be turned in at the meeting or mailed to me by 29 November 1982. All statements, both oral and written, will become part of the official record of this study and will be made available for public examination unless you specify you want your statement to remain confidential.

Please attend this meeting and help us get this study off to a successful start.

Patrick J. Kelly

PATRICK J. KELLY
Colonel, CE
District Engineer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APPROXIMATE LIMIT
OF 100 YEAR FREQUENCY FLOOD
UNDER NATURAL CONDITIONS
CITY LIMITS
LAMAR COUNTY
FORREST COUNTY
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BASIN LIMITS
ILLINOIS CENTRAL
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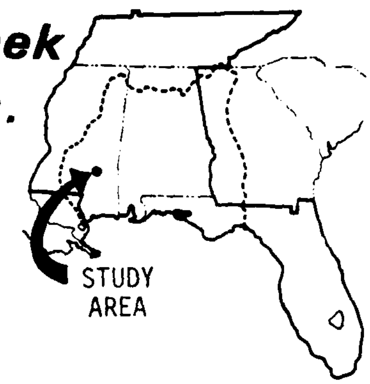
SCALE IN MILES
FLOOD PROTECTION PROJECT
GORDONS CREEK
HATTIESBURG, MISSISSIPPI

Upper Gordons Creek
Hattiesburg, Miss.



January 1983

Mobile District

US Army Corps of Engineers
Mobile District

PUBLIC INFORMATION FACT SHEET

PROBLEM IDENTIFICATION

The Mobile District of the Corps of Engineers conducted a public meeting on the Upper Gordon's Creek flooding problem on 28 October 1982 at the Saenger Theater in Hattiesburg. The purpose of the meeting was to gather information from the interested public for identification of the flood problems and for determination of public concern and preferences. The comments and views of those who attended the meeting are summarized in this fact sheet. Copies of the meeting record are available from the Corps of Engineers in Mobile at a cost of $3.00 to cover printing. Requests should be addressed to US Army Corps of Engineers, Mobile District, PO Box 2288, Mobile, Alabama 36628, ATTN: Western Basins Branch.

Views and Comments:

- Support for the Corps in the study was expressed by the Mayor and Commissioners of the City of Hattiesburg, the Director of Civil Defense for the Hattiesburg area, the Hattiesburg Homebuilders Association, the Hattiesburg Board of Realtors and the Hattiesburg East Property Owners Association.

- The Gordons Creek drainage basin has in the last 30 years been the fastest growing section of the city.

- Gordons Creek generally overflows its banks two or three times a year. The areas that are most vulnerable to flash floods include the Sunset Drive-Lincoln Road residential area, the Beverly Lane-Crestmont residential area and the Bartur Street-Broadway Drive commercial area.

- Brooklane Drive is flooded up to four times a year.

- Increased velocities on lower Gordons Creek may have damaged the River Avenue Bridge. The completed channel is not being maintained and kept clean in a satisfactory manner.

- One participant was concerned that work on Upper Gordons Creek would increase flooding on the lower portion of the creek.

- The creek banks and bottom should be lined with concrete.

- The possibility of diverting flood waters into another drainage basin should be investigated.

- Care should be taken to avoid creating erosion problems if a channel excavation plan is installed.

- The bridge openings should be studied to see if they are large enough.

- It is not likely that work on Upper Gordons Creek would affect the feasibility of a project for the Leaf and Bowie Rivers.

- Debris should be removed from the creek in the vicinity of Sunset Drive.

- The problems with flood warning systems on small drainage basins was discussed.

These comments, ideas, and suggestions which were presented by those attending the public meeting will be evaluated during the study. If we have oversighted an issue raised at the meeting, please contact Matt Laws (205) 694-3829, P.O. Box 2288 Mobile, Alabama 36628.

STUDY PROGRESS TO DATE

We are presently developing a computer model of the stream which can accurately estimate the stage of historical floods. Our model of hydrologic and hydraulic conditions is being developed for current stream and basin characteristics and will be used by the study team to determine the effects of alternative projects on water surface profiles. Flood profiles and other engineering, economic and environmental data will be used to develop and evaluate various plans for solving the flood problem.

The study team will soon be developing and evaluating the various plans and the draft report is scheduled for submission

to the Commander, South Atlantic Division in the Spring of 1984. Before submitting the report, a public workshop will be held so that everyone can review what has been studied and we can be sure that adequate alternatives have been considered. Announcement of the workshop will be made in the usual manner, and if you know of anyone who wants to be placed on our mailing list, please let Matt know.

ANNOUNCEMENT OF
PUBLIC WORKSHOP
and
PUBLIC INFORMATION BROCHURE
ON
FLOOD CONTROL PLANS
FOR

UPPER GORDONS CREEK

HATTIESBURG, MISSISSIPPI

January 1985

Workshop to be held:

Wednesday, January 30, 1985
7:00 PM
at the
City Community Center
222 Front Street
Hattiesburg, Mississippi

US Army Corps of Engineers
Mobile District

THIS IS YOUR INVITATION

The Mobile District of the Corps of Engineers is nearing completion of a detailed study of the flooding problems on the upper portion of Gordons Creek. A Public Workshop Meeting to discuss the alternatives considered and potential for Federal Assistance will be held on:

Wednesday, January 30, 1985
7:00 PM
At The
City Community Center
222 Front Street
Hattiesburg, Mississippi

Please review this brochure and attend the meeting to express your views. If you cannot attend, but wish to express your views after reading the brochure, please contact Ernie Seay, the Study Manager by phone at (205) 690-2694 or by writing to the Mobile District, Corps of Engineers, Attn: PD-W, P. O. Box 2288, Mobile, Alabama 36628-0001.

Please bring this notice to the attention of anyone you think to be interested in the flood problems along Gordons Creek.

Patrick J. Kelly
Patrick J. Kelly
Colonel, CE
District Engineer

PUBLIC INFORMATION BROCHURE

STUDY BACKGROUND

In 1979 a flood damage prevention project was completed on the lower 2.3 miles of Gordons Creek from its mouth to Broad Street. In 1980 the City of Hattiesburg requested a study of flooding problems upstream of the existing project. Authority for the study was provided by Section 205 of the Flood control Act of 1948. A map of the study area is shown on Figure 1. A public meeting was held in October 1982 to announce the initiation of the detailed study and to determine the major concerns of the residents along Gordons Creek. Based on information from the public and technical studies, we defined the flood problem and are now nearing completion of the detailed study. Our Detailed Project Report containing the Mobile District Engineer's conclusions and recommendations will be completed later this year after public review and coordination with other agencies.

FLOOD PROBLEMS

In the last 40 years, four major floods have occurred on Gordons Creek. They happened in 1947, 1957, 1961, and 1983. The April 1983 flood emphasized the severity of the flood problems in the basin and gave impetus to the need for solutions. The flood caused runoff flows that were slightly higher than the estimated 100-year flood heights for most of the stream. From rainfall and high water marks below Broad Street, the flood was estimated to be approaching the 500-year event in that area. The total damages from the storm were estimated to be approximately 14 million dollars.

Flooding along Gordons Creek was analyzed in 13 reaches and a tributary that enters the creek at Kamper Park was divided into 5 reaches. Table 1 presents a breakdown of the average annual damages by reach and damage category for Gordons Creek upstream of the existing project. The designated reaches are identified on Figure 1. The total average annual damages are estimated to be $1,272,800.

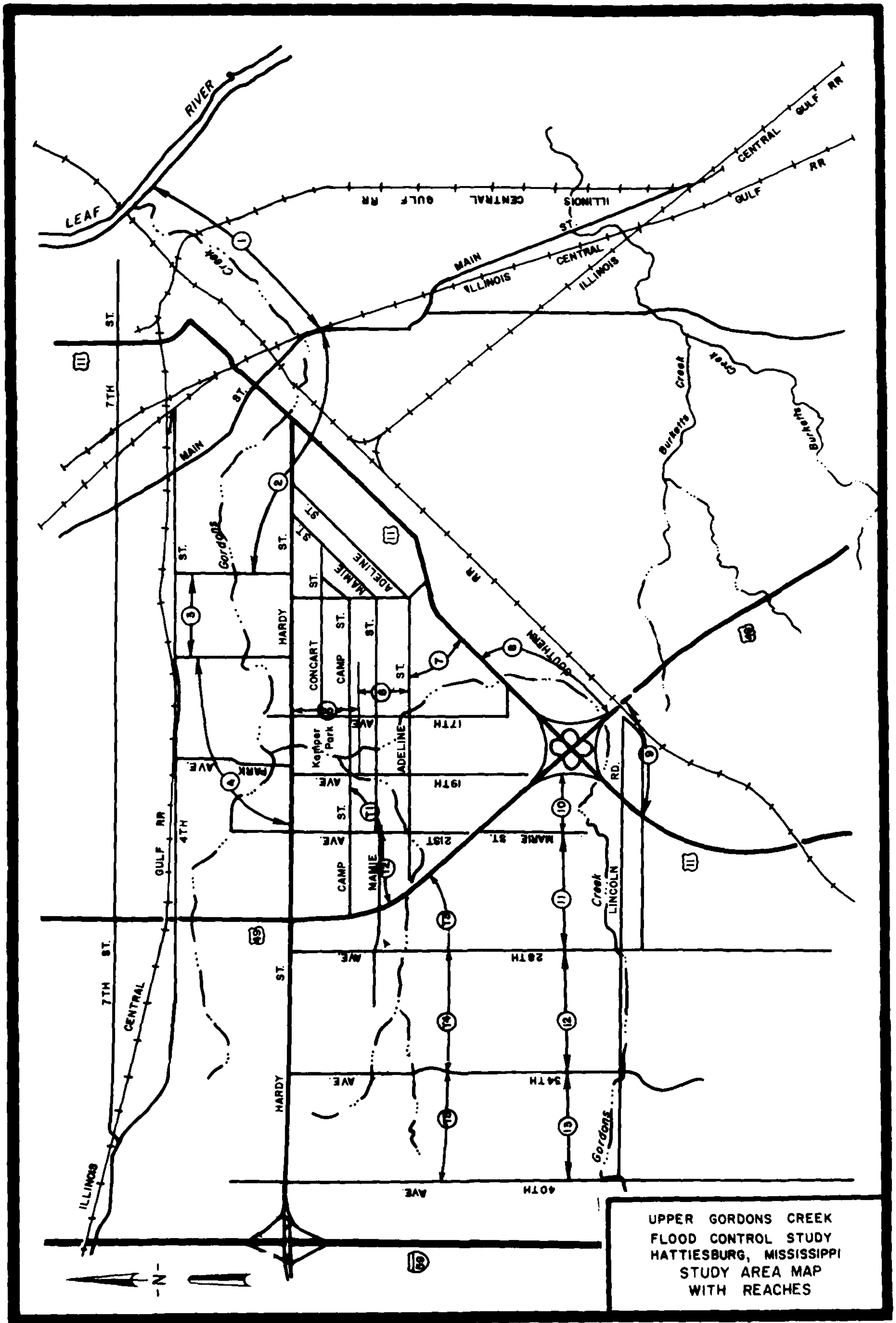

LEAF
RIVER
Creek
Gordons
ILLINOIS CENTRAL GULF RR
CENTRAL GULF RR
GULF RR
MAIN ST.
ILLINOIS CENTRAL
SOUTHERN RR
Burkette Creek
7TH ST.
4TH ST.
HARDY ST.
ST.
MAMIE ST.
ADELINE ST.
CONCART ST.
CAMP ST.
ST.
Kemper Park
17TH AVE.
PARK AVE.
19TH AVE.
21ST AVE.
MAMIE ST.
ADELINE
CAMP
MAMIE
28TH AVE.
34TH AVE.
40TH AVE.
LINCOLN RD.
11
49
59
98
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
N
UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
STUDY AREA MAP
WITH REACHES

FIGURE 1

TABLE 1

ANNUAL DAMAGE BY REACH
Values in $1,000

REACH	RESIDENTIAL STRUCTURES	COMMERCIAL STRUCTURES	PUBLIC	OTHER*	TOTAL
<u>Main Creek</u>**					
3	2.6	0.0	0.3	0.4	3.3
4	215.8	0.0	0.4	26.6	242.8
5	2.4	0.0	0.6	0.4	3.4
6	30.2	0.0	0.0	3.7	33.9
7	25.2	0.1	0.0	3.3	28.6
8	0.0	125.6	0.0	15.5	141.1
9	4.0	77.5	0.2	10.1	91.8
10	0.0	0.6	0.2	0.1	0.9
11	246.7	0.0	1.3	30.5	278.5
12	146.4	0.3	0.0	18.1	164.8
13	170.2	0.0	0.3	21.0	191.5
<u>Tributary</u>					
1	25.8	0.0	0.0	3.1	28.9
2	2.2	0.0	0.0	0.3	2.5
3	26.1	0.0	0.0	3.2	29.3
4	6.5	12.0	0.0	2.3	20.8
5	9.5	0.0	0.0	1.2	10.7
TOTAL	913.6	216.1	3.3	139.8	1,272.8

* Other damages include transportation facilities, communications lines, and utilities.

** Reaches 1 and 2 consist of the area below Broad Street.

STUDY FINDINGS

In the course of this study, various alternative flood protection measures have been considered for solving the flooding problems along Gordons Creek. A number of measures which are sometimes used in flood control have proved to be impractical. Upstream impoundment was eliminated from study because urban development is so extensive that space is not available for flood water storage. Also because of the extensive urban development, levees were found to cost more than the benefits gained.

Diversions, channel enlargement, and flood plain evacuation were judged to be the most reasonable measures for reducing the flood damages and are being considered further. Plan descriptions of the alternatives involving these measures are given below.

DIVERSION PLANS

Four routes for diversion of flood waters from Gordons Creek into Burketts Creek were investigated. For each plan it was found that the construction costs of the diversion would exceed the benefits by a considerable amount. Plan 13 was the least expensive plan. Its location is shown on Figure 2. As shown on Figure 2, the diversion would reduce flooding only for that portion of the creek downstream from Highway 49. The average annual damages for these reaches are about 40 percent of the total for the entire basin. Therefore the diversion cannot remove more than 40 percent of the flood damages in the Gordons Creek basin and if all these damages were removed, the diversion project could not be justified with benefits greater than costs.

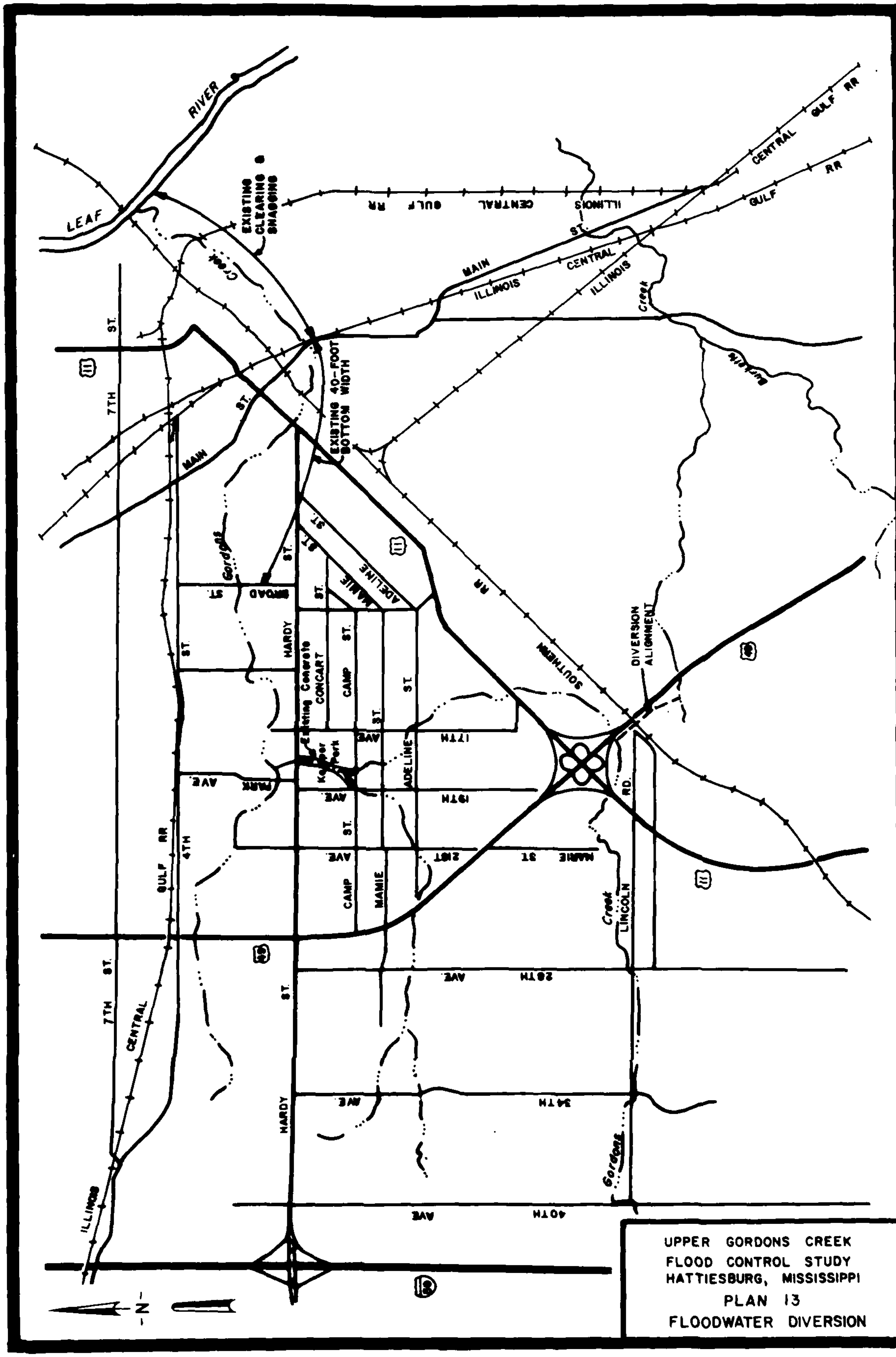

UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
PLAN 13
FLOODWATER DIVERSION
LEAF
RIVER
EXISTING CLEARING & SNAGGING
EXISTING 40-FOOT BOTTOM WIDTH
DIVERSION ALIGNMENT
MAIN ST.
ILLINOIS CENTRAL GULF RR
SOUTHERN RR
7TH ST.
HARDY ST.
BROAD ST.
ADELINE
MAMIE
CAMP ST.
CONCART
Existing Concrete
17TH AVE
19TH AVE
21ST AVE
28TH AVE
34TH AVE
40TH AVE
PARK AVE.
LINCOLN RD.
Gordons Creek
Burkets
N

FIGURE 2

CHANNEL ENLARGEMENT PLANS

The existing project on Gordons Creek consists of clearing and snagging for 1.1 miles upstream from the mouth of the creek and then an excavated channel with a 40 foot bottom width for an additional 1.2 miles.

A number of channel enlargement plans were investigated for the upper portion of Gordons Creek. An excavated channel with grassed side slopes was found to be satisfactory and would be much less expensive than a concrete or rock lined channel. However, it was found that side slopes of 1 vertical on 3 horizontal would be necessary for the excavated channel due to soil types and the depth of the existing channel. In order to minimize impacts on the existing project, excavated channels larger than the existing channel downstream of Broad Street were eliminated from the study. It was found that an upstream channel excavation plan could not be implemented without causing some adverse impacts within the upper limits of the existing project. Therefore, any channel plan recommended for Upper Gordons Creek must include measures to remove induced damages on the existing project.

The channel enlargement plans found to be reasonable for Upper Gordons Creek consist of continuing the existing project upstream for a certain distance and systematically decreasing the channel bottom width as flood peaks decrease due to less drainage area. For all the plans, the new channel would have side slopes of 1 vertical on 3 horizontal and the bottom profile of the existing creek would be maintained. Bridges and banks along outside bends in the channel would be protected by riprap. Channel enlargement of tributary streams were found to have costs greater than benefits. Therefore, the only feasible channel plans that could be found involved flooding on the main creek.

Four plans were selected as best for solving the flooding problems along the main creek and are presented in this brochure for public consideration. They have been identified as Plans 23, 24, 26, and 24B. Limits of the plans and bottom widths that were considered are shown on Figures 3 through 6.

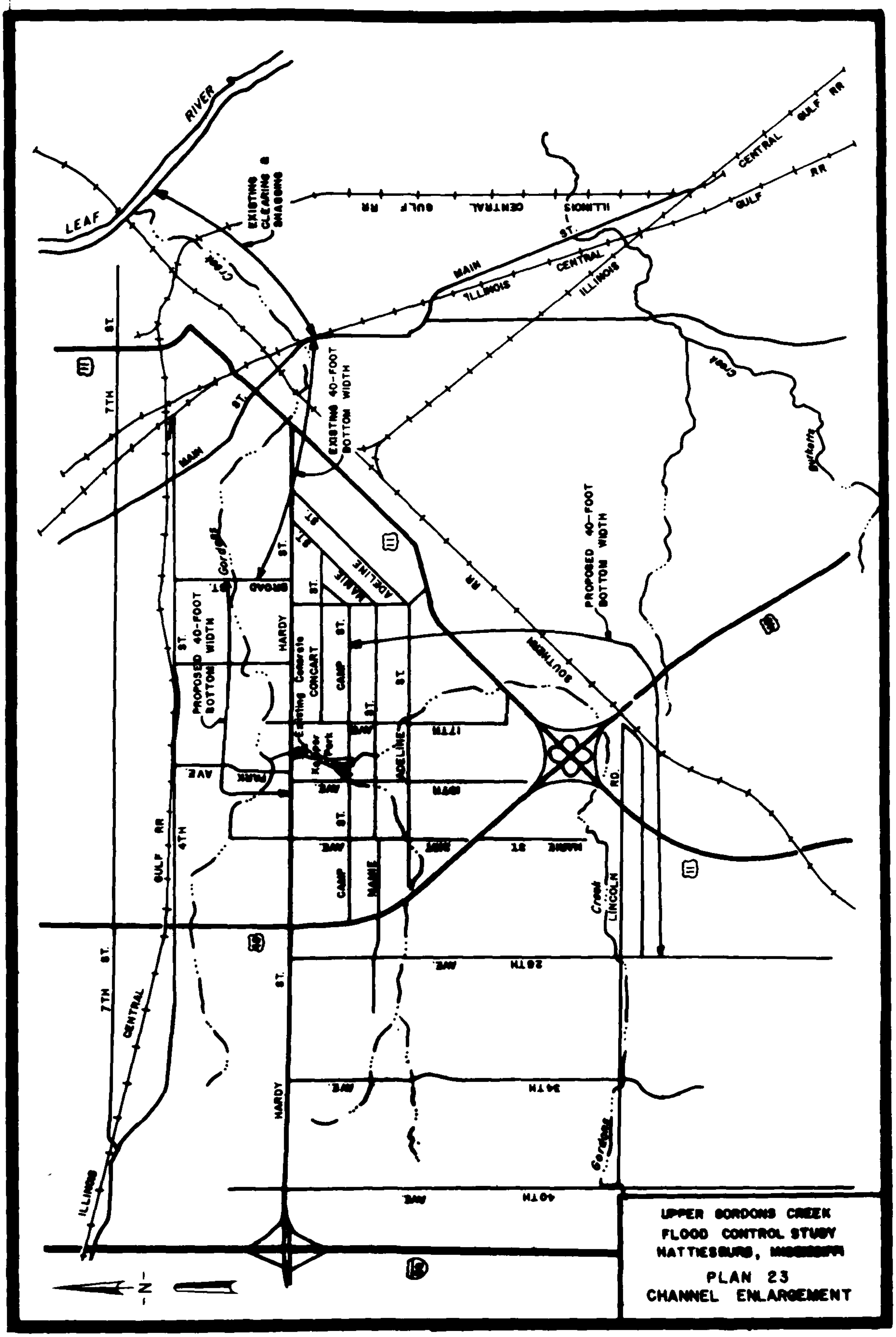

LEAF RIVER
EXISTING CLEARING & SNAGGING
ILLINOIS CENTRAL GULF RR
MAIN ST.
EXISTING 40-FOOT BOTTOM WIDTH
PROPOSED 40-FOOT BOTTOM WIDTH
SOUTHERN RR
Gordons Creek
7TH ST.
4TH ST.
HARDY ST.
BROAD ST.
ADELINE ST.
MAMIE ST.
CAMP ST.
Existing Concrete
PARK AVE.
17TH AVE.
28TH AVE.
34TH AVE.
40TH AVE.
LINCOLN RD.
UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG,
PLAN 23
CHANNEL ENLARGEMENT

FIGURE 3

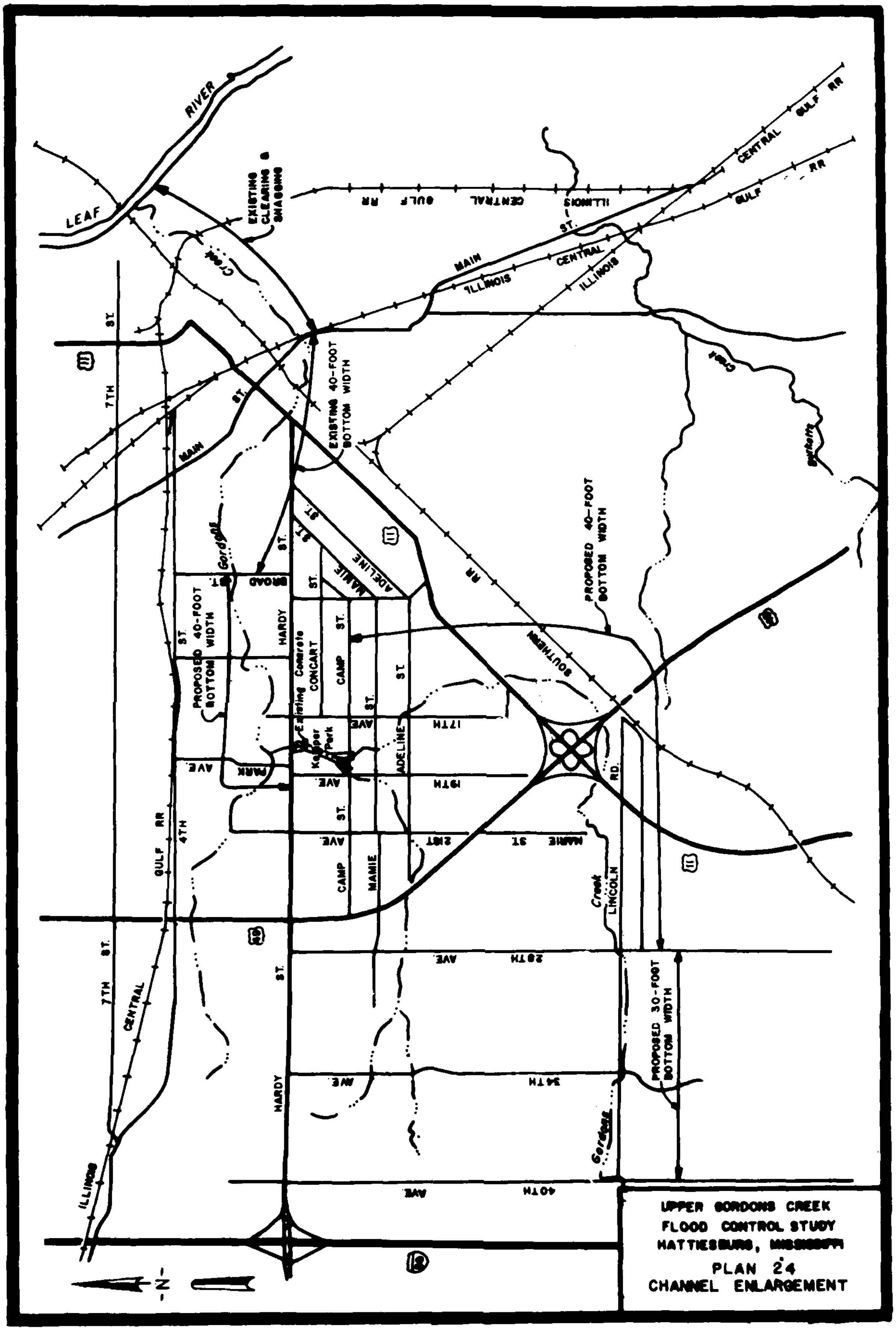

UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
PLAN 24
CHANNEL ENLARGEMENT
LEAF RIVER
EXISTING CLEARING & SNAGGING
ILLINOIS CENTRAL GULF RR
MAIN ST.
7TH ST.
4TH ST.
HARDY ST.
BROAD ST.
ADELINE ST.
MAMIE ST.
CAMP ST.
CONCART
PARK AVE.
17TH AVE.
19TH AVE.
21ST AVE.
28TH AVE.
34TH AVE.
40TH AVE.
LINCOLN RD.
SOUTHERN RR
EXISTING 40-FOOT BOTTOM WIDTH
PROPOSED 40-FOOT BOTTOM WIDTH
PROPOSED 30-FOOT BOTTOM WIDTH
Existing Concrete
Kamper Park
Gordons Creek
Bottom Creek
N

FIGURE 4

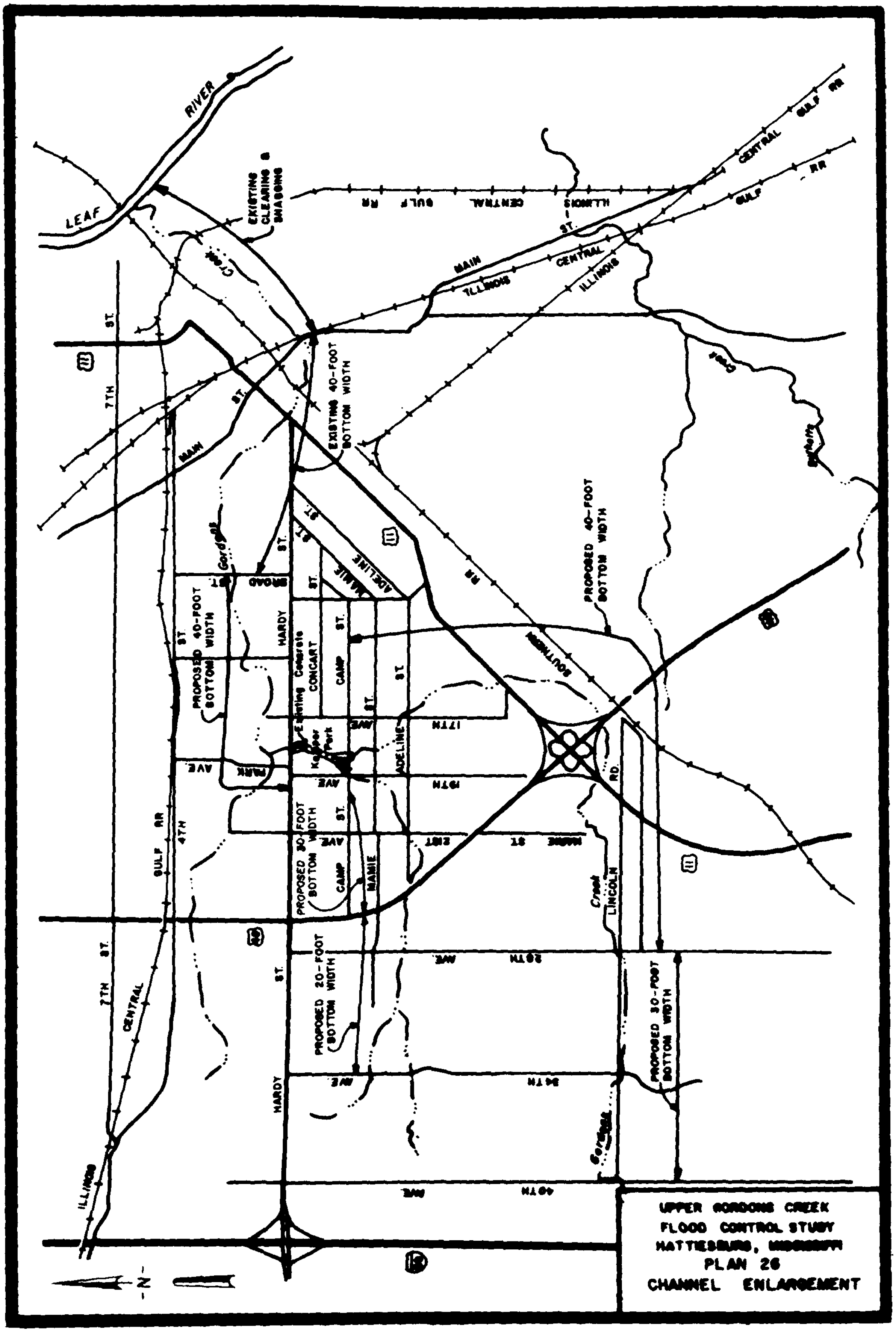
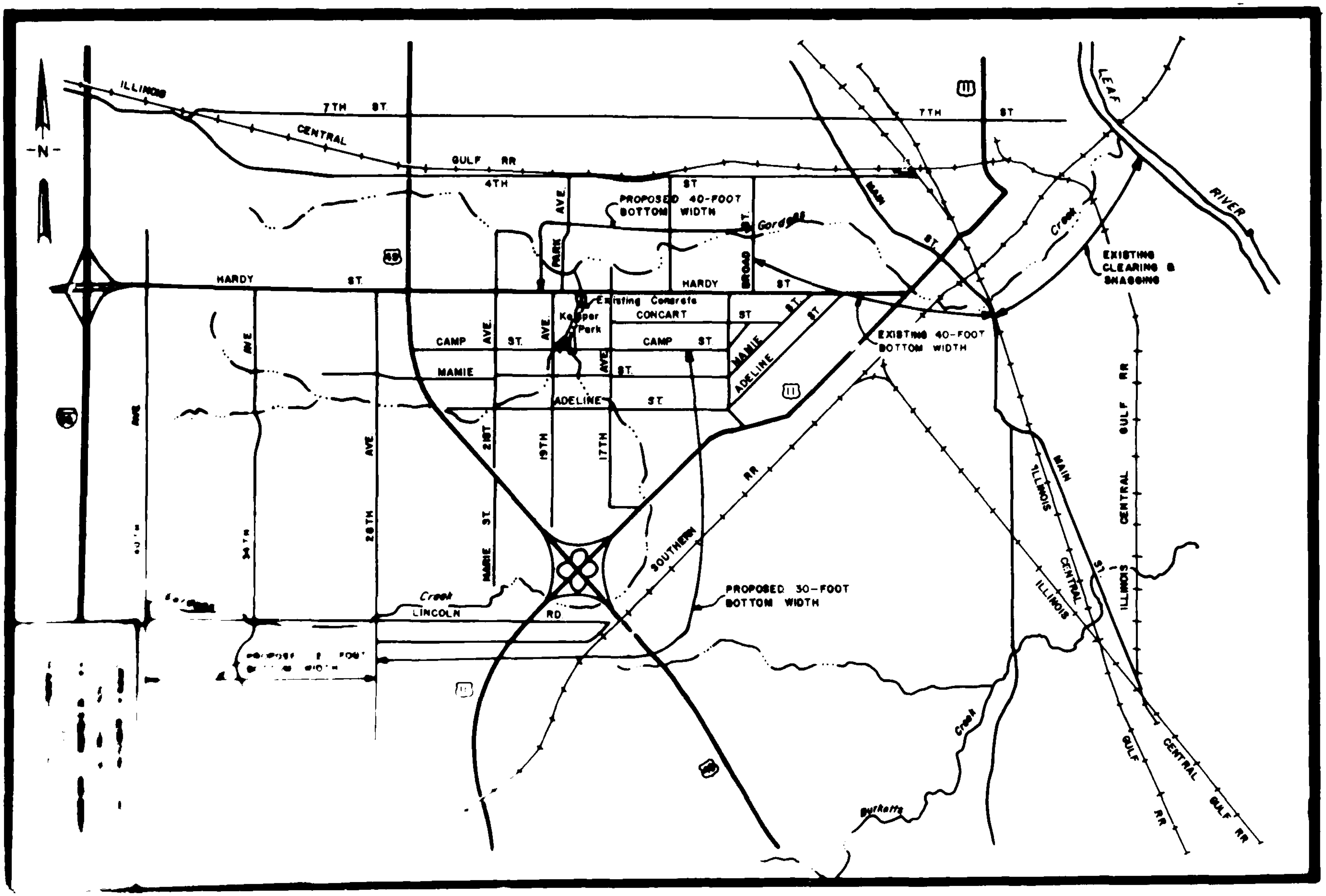

LEAF RIVER
EXISTING CLEARING & SNAGGING
EXISTING 40-FOOT BOTTOM WIDTH
PROPOSED 40-FOOT BOTTOM WIDTH
PROPOSED 40-FOOT BOTTOM WIDTH
PROPOSED 30-FOOT BOTTOM WIDTH
PROPOSED 20-FOOT BOTTOM WIDTH
PROPOSED 30-FOOT BOTTOM WIDTH
ILLINOIS CENTRAL GULF RR
SOUTHERN RR
MAIN ST.
7TH ST.
4TH ST.
HARDY ST.
BROAD ST.
ADELINE ST.
MAMIE ST.
CAMP ST.
CONCART
17TH AVE
19TH AVE
21ST AVE
25TH AVE
34TH AVE
40TH AVE
PARK AVE
LINCOLN RD.
UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
PLAN 26
CHANNEL ENLARGEMENT
N

FIGURE 5

A PAGE FOR YOUR NOTES


N
LEAF RIVER
ILLINOIS CENTRAL GULF RR
7TH ST
4TH
HARDY ST
PROPOSED 40-FOOT BOTTOM WIDTH
Gordons Creek
PARK AVE
BROAD ST
Existing Concrete
CONCART ST
Kamper Park
CAMP AVE
CAMP ST
MAMIE ST
ADELINE ST
21ST
19TH
17TH
28TH AVE
34TH
MAIN ST
EXISTING CLEARING & SNAGGING
EXISTING 40-FOOT BOTTOM WIDTH
SOUTHERN RR
PROPOSED 30-FOOT BOTTOM WIDTH
LINCOLN RD
Burkett's Creek

AD-A179 191 DETAILED PROJECT REPORT AND ENVIRONMENTAL ASSESSMENT ON UPPER GORDONS CRE..(U) CORPS OF ENGINEERS MOBILE AL MOBILE DISTRICT SEP 86 COESAM/PDW-86/004 5/5

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DATE
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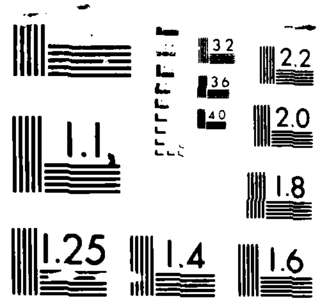


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS

EVACUATION PLANS

An analysis was made to identify the structures in the flood plain that receive enough damages from flooding to justify their removal. A nonstructural plan was developed which would remove the maximum number of structures that are feasible in flood plain areas along the creek. Only eighteen structures within the 10-year flood plain were feasible for evacuation. Locations of the structures are shown on Figure 7.

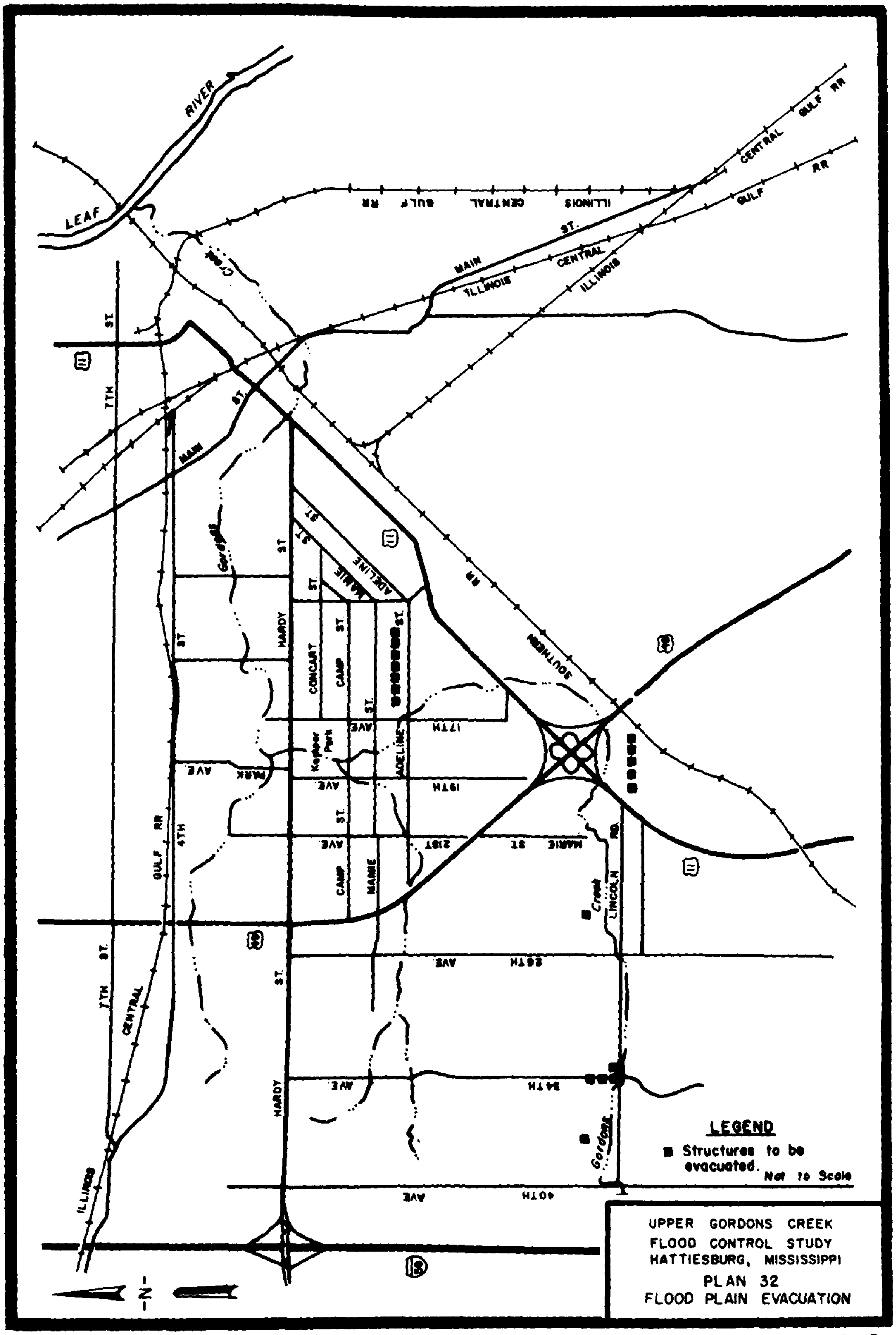

LEAF RIVER
ILLINOIS CENTRAL GULF RR
MAIN ST.
7TH ST.
4TH ST.
HARDY ST.
ADELINE ST.
MAMIE ST.
CONCART ST.
CAMP ST.
Kamper Park
PARK AVE.
17TH AVE.
19TH AVE.
21ST AVE.
28TH AVE.
34TH AVE.
40TH AVE.
LINCOLN RD.
SOUTHERN RR
Gordons Creek
LEGEND
Structures to be evacuated.
Not to Scale
UPPER GORDONS CREEK
FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI
PLAN 32
FLOOD PLAIN EVACUATION
N

FIGURE 7

PLAN SELECTION

Existing policy requires that Federal participation in a flood control project be limited to a plan with a benefit-to-cost ratio equal to or greater than one to one. All of the plans for reducing annual flood damages except the diversion plan satisfy this requirement. After identifying a number of plans with economic justification, the most important Federal objective is to define the plan with the greatest amount of net benefits. The net benefits for a plan are the annual benefits remaining after annual costs of the plan are subtracted. The plan with the greatest amount of net benefits is customarily referred to as the NED plan. An important local objective is to provide the maximum reduction in the damages being experienced under existing conditions. A summary showing the amounts for these selection factors is given on Table 2. Table 2 also shows the induced damage along the existing project downstream from Broad Street.

TABLE 2
UPPER GORDONS CREEK PLAN FORMULATION RESULTS

MEASURE	PLAN	UPPER GORDONS CREEK							EXISTING PROJECT		
		EXISTING DAMAGES $1,000	ANNUAL BENEFITS $1,000	ANNUAL COSTS $1,000	NET BENEFITS $1,000	B/C	REMAINING DAMAGES $1,000	DAMAGES REMOVED %	EXISTING DAMAGES $1,000	INDUCED DAMAGES $1,000	DAMAGES W/PLAN $1,000
DIVERSION	13	1,272.82	Costs Exceed Benefits by a Considerable Amount								
CHANNEL ENLARGEMENT	23	1,272.82	664.74	455.92	208.82	1.5	608.08	52.2	49.58	-50.03	99.61
	24	1,272.82	923.72	654.80	268.92	1.4	349.10	72.6	49.58	-51.27	100.85
	26	1,272.82	989.11	934.20	54.91	1.06	283.71	77.7	49.58	-56.86	106.44
	24B	1,272.82	859.16	559.57	299.59	1.5	413.66	67.5	49.58	-47.04	96.62
EVACUATION	32	1,272.82	188.79	126.43	62.35	1.5	1,084.03	14.8	49.58	0.00	49.58
		UPPER GORDONS CREEK COMBINED WITH THE EXISTING PROJECT									
DIVERSION	13	1,322.40	Costs Exceed Benefits by a Considerable Amount								
CHANNEL ENLARGEMENT	23	1,322.40	614.71	455.92	158.79	1.3	707.69	46.5			
	24	1,322.40	872.45	654.80	217.65	1.3	449.95	66.0			
	26	1,322.40	932.25	934.20	-1.95	1.00	390.15	70.5			
	24B	1,322.40	812.12	559.57	252.55	1.5	510.28	61.4			
EVACUATION	32	1,322.40	188.79	126.43	62.35	1.5	1,133.61	14.3			

From the detailed study of Upper Gordons Creek, Plan 24B which consists of channel enlargement on the main creek from Broad Street to Fortieth Avenue, has been identified as the NED plan. The Federal Cost for this plan is $3,422,300 and the Non-Federal cost is $2,716,700. Therefore, the total construction cost for this plan is estimated to be $6,139,000. From Table 2, the annual damages on the existing project under current conditions is $49,580. Plan 24B would cause an additional $47,040 in annual damages. Therefore, the average annual damages with the plan installed would be $96,620. A study has been performed to determine the best means of reducing these increased damages. Flood proofing has been found to be the most cost effective method for mitigation. This measure would lower the annual damages to a level below the current conditions, have benefits greater than costs, and would be the least costly alternative. Detailed data on the measure will be provided at the workshop.

Selection and implementation of the plan for mitigation is the responsibility of the Local Sponsor. Federal participation in the costs for mitigation is limited to the ratio of Federal Costs to Total Costs for the plan that is recommended for construction on the upper portion of Gordons Creek. This ratio is currently estimated to be 0.56. Therefore, the Federal contribution for the mitigation effort is limited to 56 percent of the least costly, feasible plan for reducing the impact on the existing project.

Recreation plans have not been developed at this time. However, recreation needs will be considered and coordinated with the Local Sponsor prior to completion of the Detailed Project Report. Federal expenditures for recreation features must be justified and are limited to 10 percent of the cost of the flood control project. In addition, 50 percent of any recreation development must be provided by the Local Sponsor.

PLAN IMPLEMENTATION

Implementation of a plan for flood damage reduction requires that the local sponsor (the Pat Harrison Waterway District and/or the City of Hattiesburg) provide several items of cooperation as defined in the 1936 Flood Control Act. A channel enlargement plan for Upper Gordons Creek has the following local cooperation requirements:

(1) provide all lands, easements and rights-of-way necessary for construction and maintenance of the project;

(2) accomplish all alterations and relocations of buildings, transportation facilities (except railroads), storm drains, utilities and other structures and improvements necessary for the project;

(3) fulfill the requirements as specified by the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policy Act of 1970 (PL 91-646);

(4) maintain and operate the project after completion in accordance with regulations prescribed by the Secretary of the Army;

(5) hold and save the United States free from damages due to the construction, operation and maintenance of the project when not the fault of the United States;

(6) assume responsibility for project costs in excess of the Federal cost limitation of $4,000,000; and,

(7) provide 50 percent of the first cost of recreation facilities and 100 percent of their operation and maintenance cost.

FUTURE ACTIONS BY THE CORPS OF ENGINEERS

Plan 24B appears to be the best plan, but variations of this or one of the other plans may be considered for recommendation based on local views. Review of plans at the local level is important in the selection process. The selected plan will be presented in a Draft Detailed Project Report which is scheduled for completion and public review later this year.

The Final Detailed Project Report is scheduled for completion in November 1985. Expedient processing of the report and approval of the project by the Chief of Engineers, would allow construction to begin in 1986. However, the project must compete for limited funds allocated for similar projects throughout the nation.

Any questions or comments on this brochure should be addressed to Ernie Seay, Study Manager at (205) 690-2694 or in writing as follows:

Mr. Ernie Seay
Mobile District, Corps of Engineers
Western Basins Branch
P. O. Box 2288
Mobile, Alabama 36628-0001

UPPER GORDONS CREEK

MITIGATION OF IMPACTS

ON THE

EXISTING PROJECT

INTRODUCTION

The existing project on Gordons Creek consists of clearing and snagging for 1.2 miles upstream from the mouth of the creek and then an excavated channel with a 40 foot bottom width for an additional 1.3 miles. An analysis has been made of a number of channel plans for the upper portion of Gordons Creek. Plan 27, which consists of channel enlargement and flood plain evacuation on the main creek between Broad Street to South 40th Avenue, has been selected as the plan that maximizes net economic benefits and is therefore the plan that should be recommended for construction under current Federal Guidelines. The analysis showed that an upstream channel excavation plan cannot be implemented without causing adverse impacts on the existing project. Six measures have been identified as potential solutions to mitigate the increased damages on the existing project. Descriptions of the measures and impacts are shown below.

MEASURE 1 - FLOOD WALLS AND LEVEES

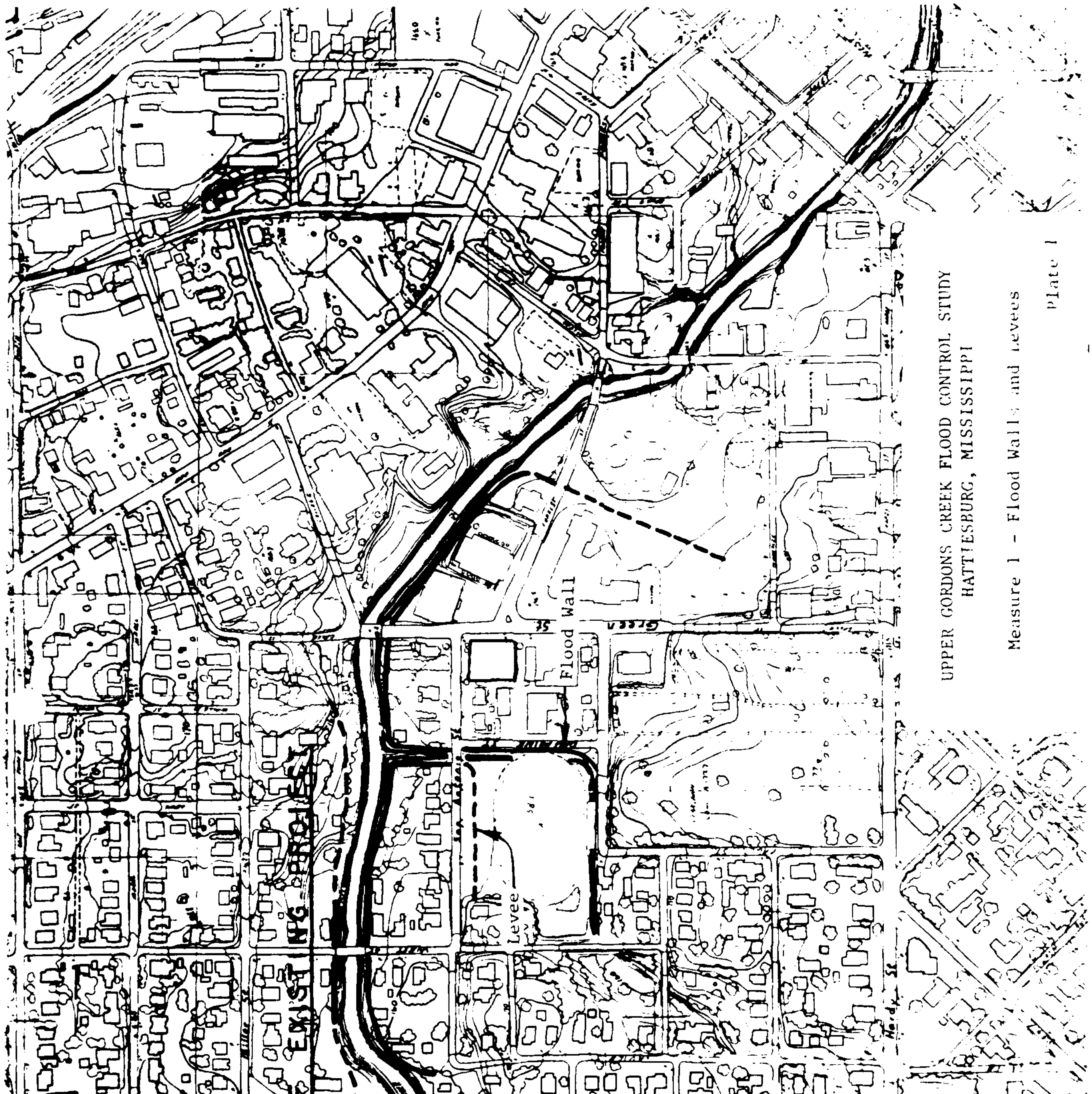
This measure consists of low level flood walls and levees on both sides of the creek between Broad Street and Forrest Street. Reinforced concrete walls were used in lieu of earth levees in areas where development has encroached upon the creek to the extent that levee construction is not practical. Elevations of the top of the walls and levees would vary from 158 to 161. They would provide protection for floods with a frequency up to approximately the 10-year event. These structures would be relatively low and would provide no protection for floods higher than elevations of 158 to 161 in the protected reach. This measure is not recommended because it could lead residents to feel they would have complete protection for any flood that could occur. In reality, they could be flooded on the average once in every ten years. Locations of the walls and levees are shown on Plate 1.

The estimated construction costs for this measure are shown on Table 1. The estimate is not complete. Complete designs for relocations, interior drainage, and closures at road crossings are not included in the estimate. Also, because the purpose for the measure is to reduce the adverse impacts of Plan 24B and not to provide complete protection, consideration for freeboard has not been included in the quantities.

TABLE 1

Estimate of Economic Costs for Flood Walls and Levees

Item	Quantity	Unit	Unit Cost	Total Cost
Flood Walls and Levees				
Concrete	1,790	CY	$200.00	$358,000
Excavation	2,626	CY	2.50	6,600
Earth Fill for Dike	5,462	CY	3.50	19,100
Seeding and Mulching	1	Ac	2,300.00	2,300
Culverts for Interior Drainage	6	Ea	2,000.00	12,000
Subtotal				398,000
Contingencies (25%)				99,500
Subtotal				497,500
Engineering and Design (10%)				49,700
Supervision and Administration (8%)				39,800
Total for Flood Walls and Levees				$587,000
Lands and Damages				
Land for Right-of-Way		Ac		
Contingencies (25%)				
Administrative Costs				
Total for Lands and Damages				Unknown
Relocations				
Bridge Modification		LS		
Contingencies (25%)				
Total for Relocations				Unknown
TOTAL MEASURE FIRST COST				$587,000



UPPER GORDONS CREEK FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI

Measure 1 - Flood Walls and Levees

Plate 1

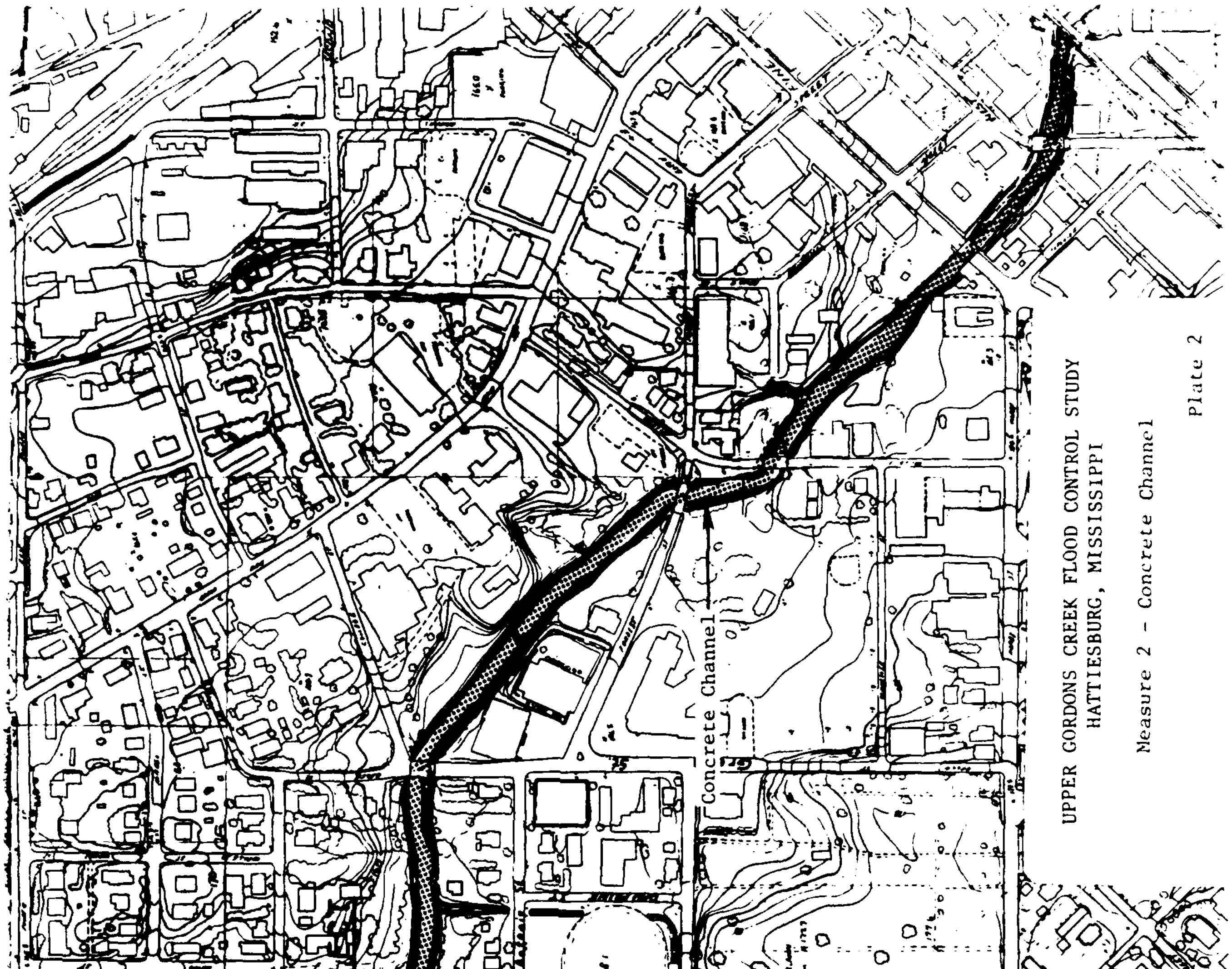
MEASURE 2 - CONCRETE CHANNEL

Measure 2 consists of concrete lining a portion of the existing flood control project on lower Gordons Creek. The concrete lined channel would extend from Broad Street downstream a distance of approximately one mile to the Southern Railroad bridge. This measure was modeled using the HEC-2 model developed for use in the Upper Gordons Creek flood control study. Reductions in flood elevations were obtained by reducing the channel roughness coefficient in the reach where the concrete would be placed. A detailed design analysis was not performed for this measure. Costs for the concrete and excavation exceeded the benefits by a considerable amount. A partial estimate of the construction costs is shown on Table 2. The limits of the concrete channel are shown on Plate 2.

TABLE 2

Estimate of Economic Costs for Concrete Channel

Description	Quantity	Unit	Unit Cost	Total Cost
Concrete Channel				
Excavation	28,210	CY	$4.00	$112,800
Concrete	18,636	CY	150.00	2,795,400
Seeding and Mulching	2.0	Ac	2,300.00	4,600
Subtotal				2,912,800
Contingencies (25%)				728,200
Subtotal				3,641,000
Engineering and Design (10%)				364,100
Supervision and Administration (8%)				291,300
Total for Concrete Channel				$4,296,400
Lands and Damages				
Land for Right-of-Way		Ac		
Structures to be Removed		Ea		
Land for Disposal Areas		Ac		
Subtotal				
Contingencies (25%)				
Administrative Costs				
Total for Lands and Damages				Unknown
Relocations				
Bridge Modification		LS		
Electric Lines		LS		
Pipelines		LS		
Subtotal				
Contingencies (25%)				
Total for Relocations				Unknown
TOTAL MEASURE FIRST COST				$4,296,400



UPPER GORDONS CREEK FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI

Measure 2 - Concrete Channel

Plate 2

MEASURE 3 - DROP STRUCTURE AND CHANNEL DEEPENING

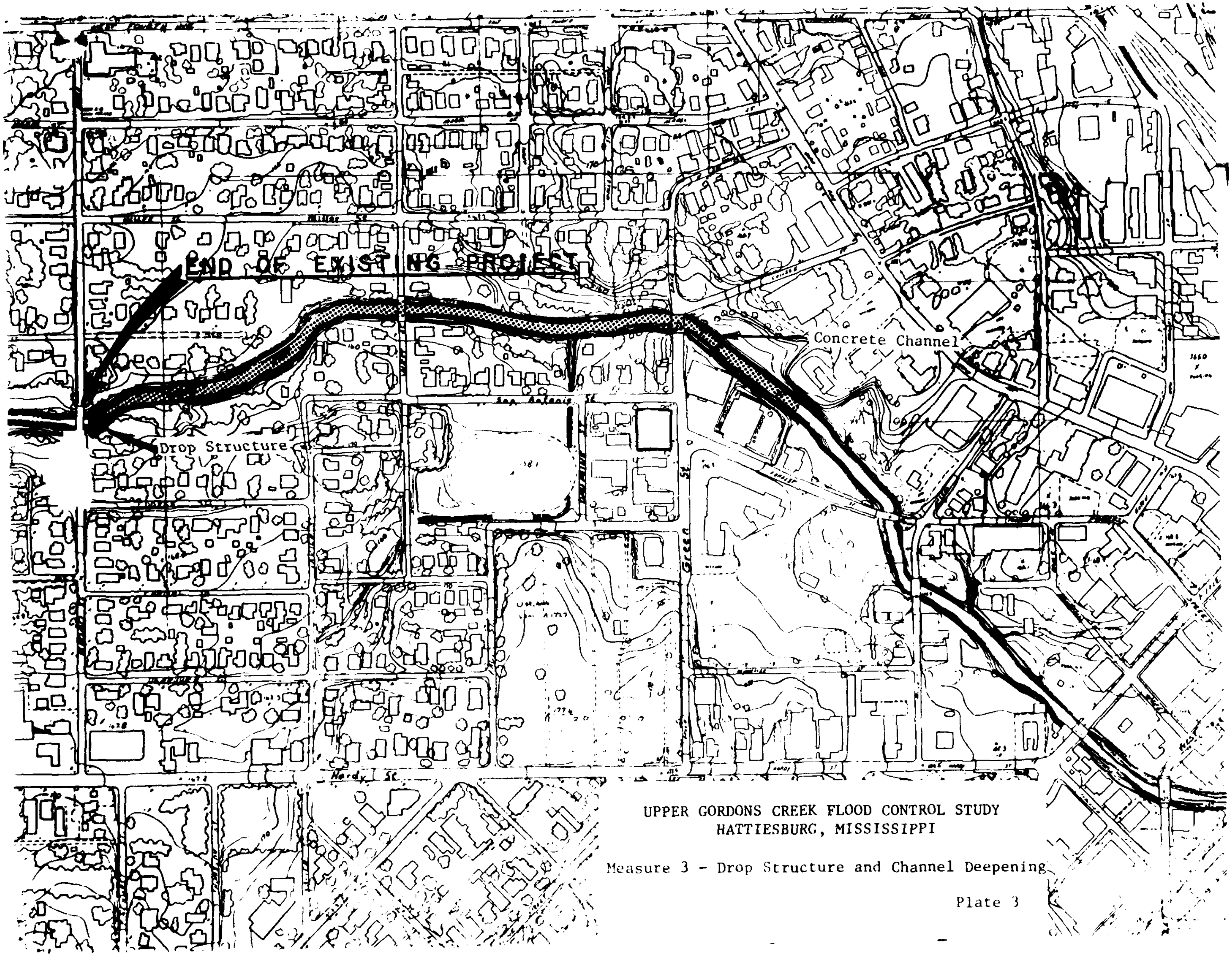
Measure 3 consists of a vertical sheet pile drop structure immediately downstream of Broad Street. The structure would lower the channel bottom approximately five feet. A 50 foot wide reinforced concrete channel would be constructed from the drop structure extending downstream approximately 3,000 feet to a point half way between Green and Forrest Streets. At this location, the slope of the concrete channel intersects the natural channel bottom of Gordons Creek. The concrete channel sides would be vertical and it is anticipated that little or no additional land for right-of-way would be required.

This measure was modeled using the HEC-2 model developed for the flood control study on Upper Gordons Creek. Reductions in flood elevations were obtained by a combination of lowering the channel bottom and reducing the channel roughness coefficient. A detailed design was not performed. Quantities and unit prices were estimated for concrete, excavation, and sheet piles. At this point, average annual costs exceeded benefits and no further study was performed. Consideration for relocations, disposal areas, and water control during construction are not included in the cost estimate. A partial estimate of the construction costs is shown on Table 3. The location of the structure and limits of channel excavation are shown on Plate 3.

TABLE 3

Estimate of Economic Costs
Drop Structure and Channel Deepening

Description	Quantity	Unit	Unit Cost	Total Cost
Drop Structure and Channel Deepening				
Sheet Pile	42	Tn	$1,200.00	$50,400
Excavation and Back Fill	15,299	CY	3.00	45,900
Excavation and Disposal	45,434	CY	4.00	181,700
Riprap	3,147	CY	50.00	157,400
Concrete	14,667	CY	250.00	3,666,800
Seeding and Mulching	0.0	Ac	2,300.00	0
Subtotal				4,102,200
Contingencies (25%)				1,025,500
Subtotal				5,127,700
Engineering and Design (10%)				512,800
Supervision and Administration (8%)				410,200
Total for Drop Structure and Channel				$6,050,700
Lands and Damages				
Land for Right-of-Way		Ac		
Land for Disposal Areas		Ac		
Subtotal				
Contingencies (25%)				
Administrative Costs				
Total for Lands and Damages				Unknown
Relocations				
Bridge Modification		LS		
Electric Lines		LS		
Pipelines		LS		
Subtotal				
Contingencies (25%)				
Total for Relocations				Unknown
TOTAL MEASURE FIRST COST				$6,050,700



UPPER GORDONS CREEK FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI

Measure 3 - Drop Structure and Channel Deepening

Plate 3

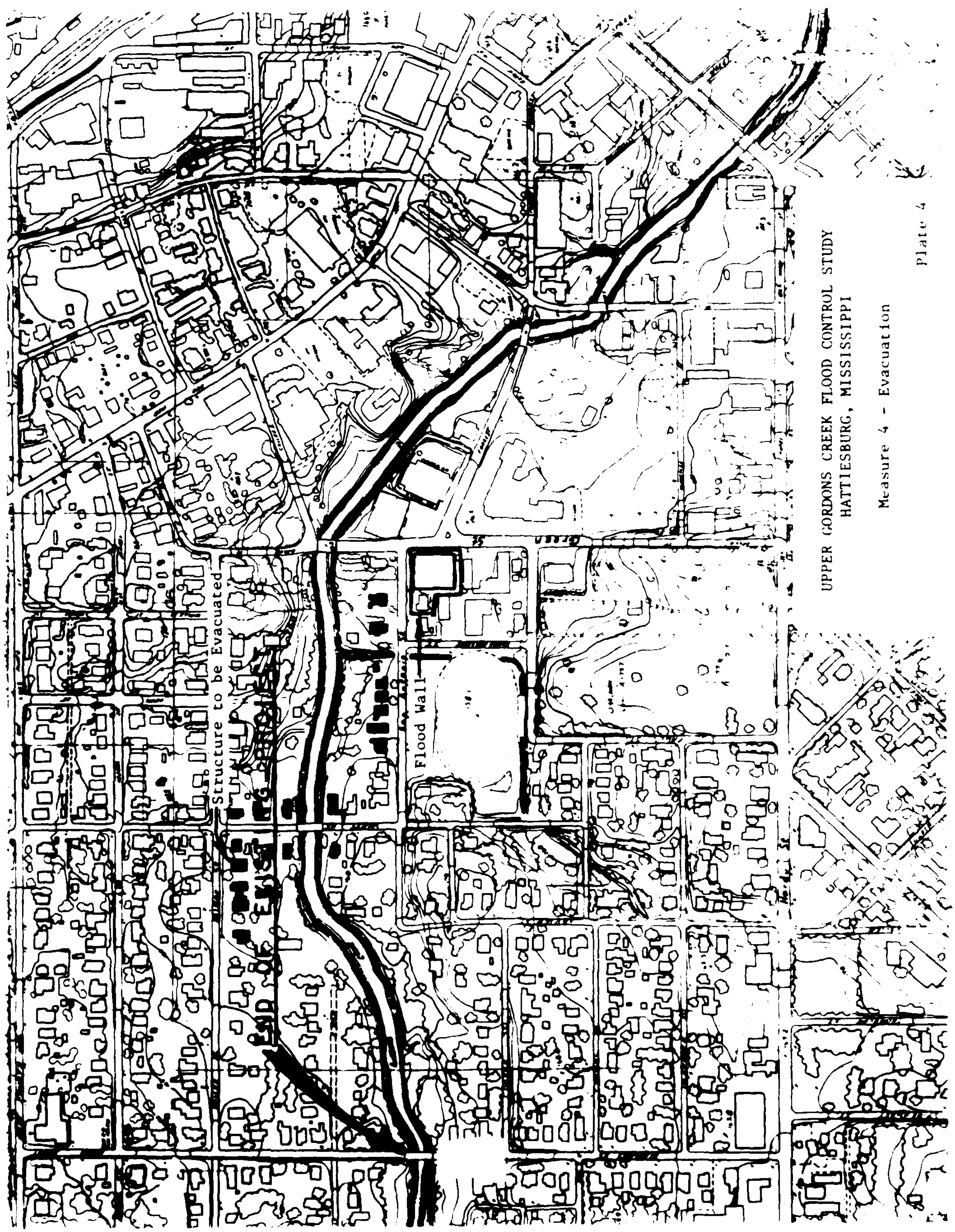
MEASURE 4 - EVACUATION

This measure consists of the evacuation of 21 residences between Broad Street and Green Street. In addition, the Hattiesburg Fitness Center, downstream from Green Street, would be flood proofed to the elevation of the 100-year storm as a part of this measure. The estimated construction costs are shown on Table 4. Locations of the structures are shown on Plate 4.

TABLE 4

Estimate of Economic Costs for Flood Plain Evacuation

Description	Quantity	Unit	Unit Cost	Total Cost
Property Acquisition				
Value of Land and Structures	21	Ea	Varies	$785,400
Contingencies (25%)				196,300
Administrative Costs	21	Ea	$3,000.00	63,000
Total Costs for Property Acquisition				$1,044,700
Site Reclamation				
Remove Utilities	21	Ea	400.00	8,400
Remove Structures	21	Ea	1,500.00	31,500
Remove Foundations	21	Ea	300.00	6,300
Grade and Grass Site	21	Ea	500.00	10,500
Subtotal				56,700
Contingencies (25%)				14,200
Total Costs for Site Reclamation				$70,900
Salvageable Items	21	Ea	-3000.00	(63,000)
Sealing				
Concrete	133	CY	200.00	26,600
Excavation	800	CY	5.50	4,400
Earth Fill	800	CY	6.50	5,200
Interior Drainage	1	LS	600.00	600
Sewer Modifications	1	LS	500.00	500
Landscaping	1	LS	1,500.00	1,500
Subtotal				38,800
Contingencies (25%)				9,700
Subtotal				48,500
Engineering and Design (10%)				4,800
Supervision and Administration (8%)				3,900
Total Costs for Sealing				$57,200
PL 91-646 Cost	21	Ea	1[illegible],000.00	$315,000
TOTAL MEASURE FIRST COST				$1,424,800



UPPER GORDONS CREEK FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI

Measure 4 - Evacuation

Plate 4

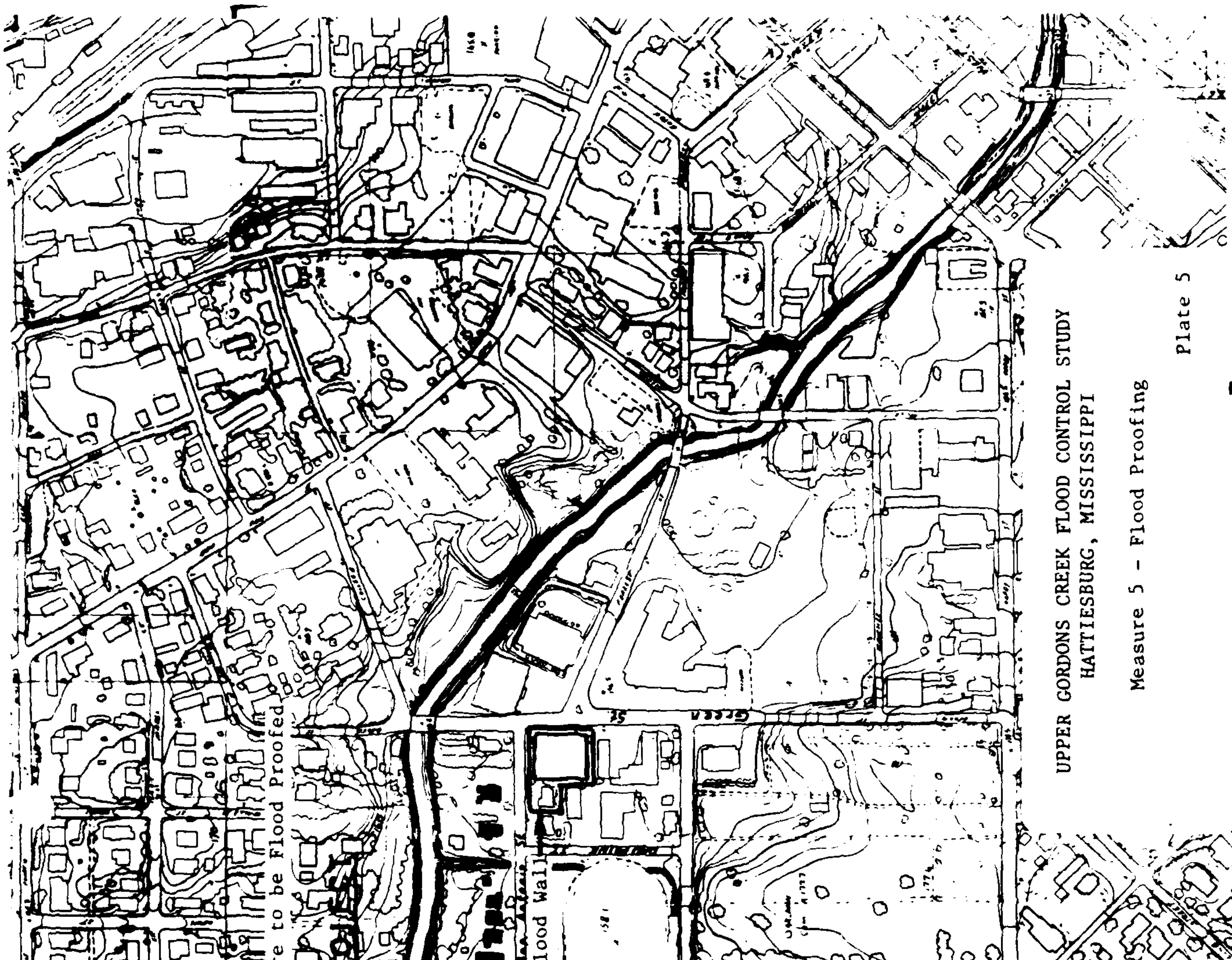
MEASURE 5 - FLOOD PROOFING

This measure consists of raising the first floors of 21 residences between Broad Street and Green Street and sealing flood waters away from the Hattiesburg Fitness Center. All structures would be protected to the elevation of the 100-year flood with Plan 27 installed. Installation of the measure will provide protection to the level of the 100-year flood for the structures receiving induced damages. Of the 21 houses, six would be raised three feet, nine would be raised two feet, and six would be raised one foot. The houses are single story structures on piers. The following actions are estimated to be required to raise the structures in place: (1) disconnect all plumbing, wiring and utilities which cannot be raised and raise the structure to the desired elevation with steel beams and hydraulic jacks, (2) extend the existing foundation or construct a new foundation, reconnect all plumbing wiring and utilities and adjust walks, steps and ramps as necessary and (3) regrade the site. The Hattiesburg Fitness Center would be flood proofed by constructing a flood wall with a height of two feet to encompass the structure. The estimated construction costs are shown on Table 5. Locations of the structures are shown on Plate 5.

TABLE 5

Estimate of Economic Costs for Flood Proofing

Description	Quantity	Unit	Unit Cost	Total Cost
Raising in Place				
Raising the House	21	Ea	$2,100.00	$44,100
Foundation Work	21	Ea	2,000.00	42,000
Landscaping	21	Ea	1,000.00	21,000
Temporary Housing	21	Ea	500.00	10,500
Subtotal				$117,600
Sealing				
Concrete	133	CY	200.00	26,600
Excavation	800	CY	5.50	4,400
Earth Fill	800	CY	6.50	5,200
Interior Drainage	1	LS	600.00	600
Sewer Modifications	1	LS	500.00	500
Landscaping	1	LS	1,500.00	1,500
Subtotal				$38,800
Total for Raising and Sealing				156,400
Contingencies (25%)				39,100
Subtotal				195,500
Engineering and Design (10%)				19,500
Supervision and Administration (8%)				15,600
TOTAL MEASURE FIRST COST				$230,600



UPPER GORDONS CREEK FLOOD CONTROL STUDY
HATTIESBURG, MISSISSIPPI

Measure 5 - Flood Proofing

Plate 5

MEASURE 6 - CASH PAYMENTS

The Flood Insurance Premiums for the structures that are experiencing most of the increase in average annual damages are estimated to total $6,890 per year. This total does not include structures that are already owned by the city of Hattiesburg.

SUMMARY

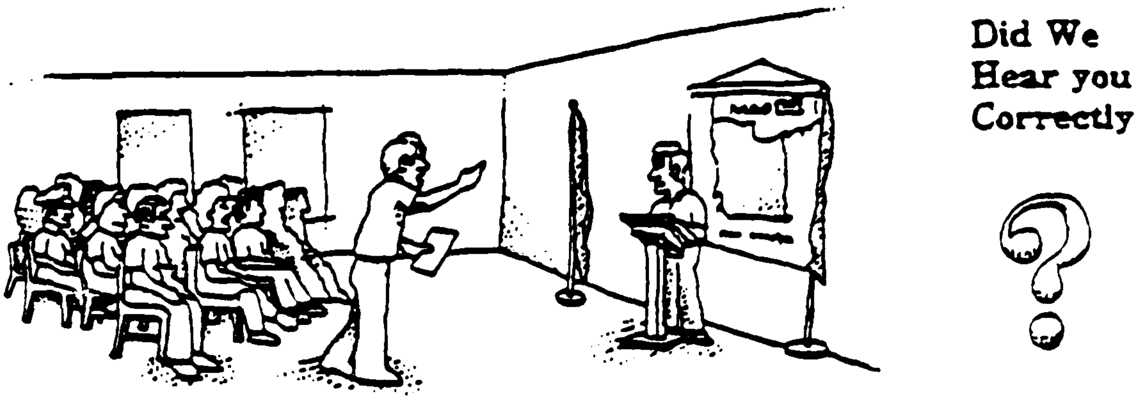
The annual damages on the lower 2.5 miles of Gordons Creek would be $431,680 if the existing project was not constructed. The annual damages on the existing project under current conditions is $72,650. Plan 27 would cause an additional $27,480 in annual damages. Therefore, the average annual damages with the plan installed would be $100,130. The costs and effectiveness of removing damages for each of the mitigation measures are shown on Table 6.

Table 6
(Values in $1,000)

Measure	Project Costs from Table 1 thru Table 5	Current Damages	Induced Damages	Damages Reduced	Percent of Induced Damages Removed
Walls & Levees	587.0	72.65	27.48	30.27	110
Concrete Channel	4,296.4	72.65	27.48	34.45	125
Drop Structure	6,050.7	72.65	27.48	14.46	53
Evacuation	1,424.8	72.65	27.48	51.62	188
Flood Proofing	230.6	72.65	27.48	55.78	203
Cash Payments		72.65	27.48	0	0

Based on our analysis of the costs and impacts, flood proofing is the most cost effective method for mitigating the damages caused by Plan 27. This measure would lower the annual damages to a level below the damages under current conditions and would be considerably less expensive than the other measures investigated. The benefit-to-cost ratio for the measure is estimated to be 2.8.

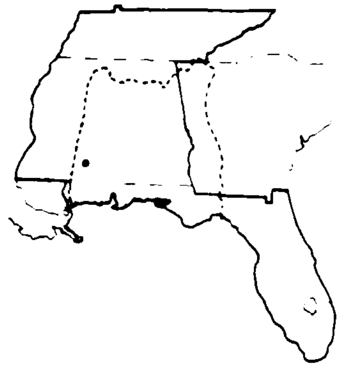
Selection of the plan for mitigation is the responsibility of the local sponsor. Federal cost sharing for mitigation will be based on the ratio of Federal Costs to Total Costs for the plan that is recommended for construction on the upper portion of Gordons Creek. This ratio is currently estimated to be 0.45. Therefore, the Federal contribution for the mitigation effort will be 0.45 of the most cost effective plan for reducing the impact on the existing project. The Federal contribution is currently estimated to be $104,400. Should the local sponsor implement an alternative other than the most cost effective plan, the Federal contribution would be limited to 0.45 of the most cost effective plan.



THIS IS WHAT WE HEARD YOU SAY AT THE WORKSHOP ON GORDONS CREEK HATTIESBURG, MISSISSIPPI

Gordons Creek

Hattiesburg, Mississippi



February 1985

Mobile District

US Army Corps of Engineers

Mobile District

PUBLIC INFORMATION FACT SHEET

PURPOSE OF THE FACT SHEET

The Mobile District of the Corps of Engineers is nearing completion of a detailed study of the flooding problems in the Gordons Creek drainage basin. The study is being conducted under authority contained in Section 205 of the 1948 Flood Control Act, as amended. Gordons Creek has an existing clearing and snagging and channel enlargement project on the lower 2.3 miles of the creek which was constructed in 1979. The existing project extends from the mouth of the creek upstream to Broad Street. In addition, work is underway to construct a clearing and snagging project on the Leaf River in the area upstream and downstream of the mouth of Gordons Creek. The current study focuses on flooding problems along Gordons Creek from Broad Street to South 40th Avenue and a tributary from its mouth at Kamper Park to South 34th Avenue.

On January 30, 1985, the Mobile District conducted a Public Workshop in the City Community Center, 222 Front Street, Hattiesburg, Mississippi. About 100 people attended the workshop. The purpose of the workshop was to discuss the results of the Corps' study and to determine local views of the study's tentative conclusions. A feasible plan involving channel enlargement was described and a question and answer session was held. The plan was identified as the alternative with the greatest amount of net benefits. It consists of an excavated channel from Broad Street upstream on the main creek to the intersection of Lincoln Road and South 40th Avenue. The channel would have side slopes of 1 vertical on 3 horizontal and bottom widths of 40 feet between Broad Street and Hardy Street, 30 feet between Kamper Park and South 28th Avenue, and 20 feet between South 28th Avenue and South 40th Avenue.

Installation of the plan would increase flood heights on the portion of the existing project immediately downstream of Broad Street. However, the increase will not amount to as much as the flooding that would have occurred without the existing project. Alternative proposals to mitigate increased flood damages on the existing project were described. The workshop attendees were informed that mitigation will be the responsibility of the local sponsor and would be undertaken during construction of the proposed project. Flood proofing was identified as the most cost effective measure for mitigation of induced damages.

THIS IS WHAT WE HEARD

The comments expressed and questions asked at the workshop along with the Corps' response are as follows:

- Support for the proposed plan was expressed by residents along the upstream portion of the creek.

- Residents along the existing project expressed opposition to any additional work by the Corps of Engineers in the basin.

  a. Dissatisfaction was expressed on the performance of the existing project.

  b. Maintenance is not being performed on the existing project to the satisfaction of some residents in the area.

  c. Concern was expressed that development on the creek has not been adequately restricted in the vicinity of Broad Street to Pine Street. The recent construction of a new bank on the creek at Pine Street was mentioned as an example.

  d. Concern was expressed because of flooding around the bridge on West Street (existing project) during the April 1983 flood.

  e. Concern was expressed that the Southern Railroad trestle on the existing project acts to impede flood flows.

  f. The opinion was expressed that inadequate bridge openings are a primary cause of flooding on the creek and that no work is being done to enlarge the bridges.

- The flood of April 1983 caused flooding almost to the level of the 500-year event in the vicinity of Broad Street. Lower Gordons was constructed with a capacity to pass the 15-year event with minor damages and the capacities of bridges crossing the creek are adequate for the project as designed. During the 1983 flood, the design capacity of the project was far exceeded, however the flood would have caused even more damages if the project had not been constructed. Other floods since 1979 have been rather small, 10-year frequency or less, with some out-of-bank flows but very small damages.

• Who decided that a flood wall would be constructed around the Hattiesburg Racquetball and Fitness Center and that residents in the area would not receive flood walls and why?

- The Mobile District found that the fitness center would receive greater damages if upstream work is undertaken, therefore flood wall protection is needed to mitigate the increased flood levels. It is more practical and economical to raise residential structures than to protect them with flood walls. If structures are protected by flood walls, steps must be taken to prevent flood waters from by-passing the wall through sewers and other openings and a pump is ordinarily required to remove water inside the wall until flood waters subside. However, a flood wall was proposed for the fitness center because the building is a metal and brick structure on a concrete slab and cannot be easily raised.

• How were the estimates of damages along the creek made?

- Fair market valuations of real estate within the study area were made by Mobile District personnel and estimates of amount of damage for various levels of flooding were taken from historical data provided by the Federal Emergency Management Agency. These data (stages and damages) were subjected to traditional frequency data (probabilities of flooding) to estimate damages on an annual basis.

• Would mitigation work on the existing project be done at the same time as the channel enlargement plan is installed?

- Yes.

- How does the City of Hattiesburg plan to finance mitigation of damages to residents on the existing project?

- Financing for mitigation is a responsibility of the local sponsor, the Pat Harrison Waterway District. There is adequate time to settle this issue before the project is authorized.

- Would the Corps of Engineers begin construction on the proposed project without requiring mitigation of damages on the existing project?

- No.

- Would the City of Hattiesburg install the proposed project without mitigation of flood damages on the existing project?

- City officials as well as the local sponsor have stated their support for mitigation.

- Can the Corps of Engineers come back to do something about flooding on the existing project after the proposed upstream project is constructed?

- Under the authority of Section 205 of the Flood Control Act of 1948, we cannot do additional work on a completed Federal project.

- How far will you work up Gordons Creek during construction of the Leaf and Bowie Rivers project?

- The Leaf and Bowie project will include clearing in the flood plain and possibly shaping of the Leaf River bank at the mouth of Gordons Creek. Improvement in the capacity of Gordons Creek will not be provided.

- Will silt be removed at the mouth of Gordons Creek during construction of the Leaf and Bowie Rivers project?

- No. If maintenance of the existing project on Gordons Creek is needed, the local sponsor is required to provide that service.

- Would the proposed project cause more siltation in the lower portion of the existing project and thus increase operation and maintenance?

- Increased operation and maintenance on the existing project is a likely consequence of the proposed project. These costs have been considered in the determination of project feasibility for the upstream work.

- If the project is installed, is there a guarantee that you will later divert some water out of Gordons Creek and the tributary at Kamper Park instead of letting it all come down on us at Park Avenue?

- No. Our studies of diversion alternatives indicate that none are feasible and no further study is planned. The proposed channel enlargement project would significantly reduce flood damages in the Park Avenue area.

- Is work planned for the tributary that runs alongside the Forrest General Hospital and enters Gordons Creek at Kamper Park?

- Our studies indicate that significant flood damages do occur on the tributary, but reduction measures that would qualify for Corps of Engineers implementation are not feasible.

- Will the bridge on Highway 49 near the Forrest General Hospital be enlarged?

- Modification of the Highway 49 bridge is not included in the project presented for Upper Gordons Creek.

- How much easement will be required?

- The proposed plan includes an easement of 15 feet on each side of the constructed channel. Restrictions would be placed in this area to prevent the construction of any permanent structures or the removal of any trees. However, in areas where the easement is a part of back yards, normal use of the area by growing trees, shrubs, grass, or gardens would not be restricted.

- Wouldn't the side slopes of 1 vertical on 3 horizontal along City Park Circle actually take all of the yards?

- The channel alignment for the proposed project has been selected to utilize opposite banks to the utmost in areas where development extends to the bank on one side. In the City Park area, the channel alignment will be positioned so that most back yards would be reduced but not totally lost.

- Concern was expressed that the total top width of the proposed channel is greater than available lands in some areas along the creek.

- From the 2-foot contour topographic mapping supplied by the City of Hattiesburg, it appears that the creek can be enlarged to the proposed dimensions for the entire length of the project provided that seven structures are removed. For any location on the stream, the width of the project including right-of-way may be estimated from the depth of the existing creek. The total width would be equal to the proposed channel bottom width plus six times the channel depth plus an additional 30 feet for right-of-way.

- Will the concrete channel bank in the back yards of houses on Sunset Drive be removed by the proposed plan?

- No. New work would be accomplished on the opposite bank.

- Did the Corps of Engineers consider restrictions of development and measures to reduce runoff from development in the uppermost portion of the basin as a measure to reduce flooding?

- Subdivision restrictions are a local matter that would be handled by the City of Hattiesburg. However, increased runoff as a result of future development was considered in the assessment of project benefits and level of protection.

WHAT HAPPENS NEXT?

The next step in the study is to obtain assurance that the local sponsor will participate in implementation of the plan and complete the Detailed Project Report. At this time we intend to recommend construction of a channel enlargement plan to reduce flood damages along Upper Gordons Creek. The proposed plan will consist of channel enlargement on the main creek from Broad Street upstream to the intersection of Lincoln Road and South 40th Avenue. The final report is scheduled for completion in September 1985. Expedient processing of the report and approval of the project by the chief of Engineers in Washington, DC, could possibly allow construction of the project to begin in 1986. However, the project must compete with other projects throughout the nation for limited funds.

Thank you for your participation in the workshop, and for providing your views on the study and its findings. Citizens affected by flooding from Gordons Creek should continue to express their desires to their local government officials as the opportunity arises. Additional fact sheets will be issued as necessary to keep you informed of future progress.

Ernie Seay

Ernie Seay
Study Manager
(205) 690-2694

ANNOUNCEMENT OF PUBLIC WORKSHOP and PUBLIC INFORMATION BROCHURE ON FLOOD CONTROL PLANS FOR

UPPER GORDONS CREEK

HATTIESBURG, MISSISSIPPI

July 1986

Workshop to be held:

Tuesday, July 15, 1986
7:00 PM
at the
Jackie Dole Community Center
222 Front Street
Hattiesburg, Mississippi

US Army Corps of Engineers
Mobile District

THIS IS YOUR INVITATION

The Mobile District of the Corps of Engineers performed a detailed study of the flooding problems on the upper portion of Gordons C eek and presented the tentative results to you in a workshop held in January 1985. At the request of the City of Hattiesburg, the study was continued and additional alternatives have been evaluated. A Public Workshop Meeting to discuss the additional alt rnatives and the potential for Federal Assistance will be held on.

Tuesday, July 15, 1986
7 00 PM
At The
Jackie Dole Community Center
222 Front Street
Hattiesburg, Mississippi

Please review the enclosed information and attend the meeting to express your views. If you cannot attend, but wish to express your views after reading the brochure, please contact Ernie Seay, the Study Manager by phone at (205) 690 2694 or by writing to the Mobile District, Corps of Engineers, Attn. PD-W, P. O. Box 2288, Mobile, Alabama 36628-0001.

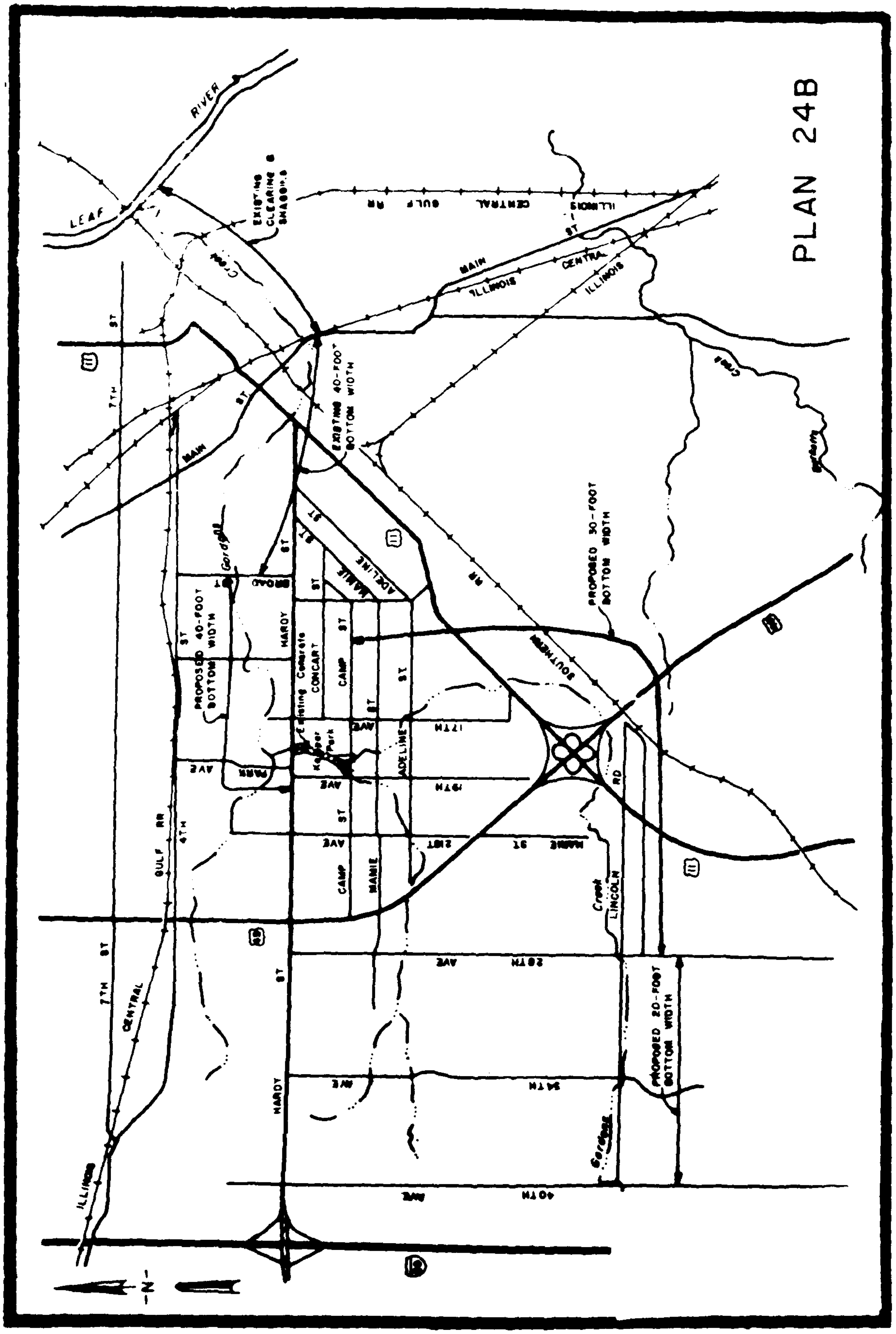
Please bring this notice to the attention of anyone you think to be in erested in the flood problems along Gordons Creek.

C. Hilton Dunn Jr.
Colonel, CE
District Engineer

STUDY FINDINGS

At the workshop last year, Plan 24B was identified as the NED plan and supported by the Mobile District to be the best plan for construction. Plan 24B consists of channel enlargement on the main creek from Broad Street to Fortieth Avenue with bottom widths ranging from 40 to 20 feet and side slopes of one vertical on three horizontal. Plan 24B is shown on Figure 1.

Two additional alternatives have been evaluated. They are identified as Plans 27 and 28. Plan 27 consists of channel enlargement with the same bottom widths and side slopes as Plan 24B. The limits of work extend from Broad Street to Fortieth Avenue in a similar manner as Plan 24B except no work would be performed in the portion of the stream between Kamper Park and Broadway Drive (U.S. Highway 11). Seven residences on Brooklane Street and one residence on South 17th Avenue were found to be feasible for evacuation and are included in the plan. Plan 28 also consists of channel enlargement with the same bottom width and side slopes as Plan 24B. The limits of work extend from Broad Street to Fortieth Avenue. However, for this plan no work would be performed between Kamper Park and U.S. Highway 49 upstream. The eight residences on Brooklane Street and South 17th Avenue would also be evacuated with this plan. Plans 27 and 28 are shown on Figures 2 and 3.



PLAN 24B
LEAF
RIVER
EXISTING CLEARING & SNAGGING
EXISTING 40-FOOT BOTTOM WIDTH
PROPOSED 30-FOOT BOTTOM WIDTH
PROPOSED 40-FOOT BOTTOM WIDTH
PROPOSED 20-FOOT BOTTOM WIDTH
ILLINOIS CENTRAL GULF RR
MAIN ST
HARDY ST
7TH ST
4TH ST
BROAD ST
ADELINE ST
MAMIE ST
CAMP ST
CONCART
Existing Concrete
Kamper Park
PARK AVE
17TH AVE
19TH AVE
21ST AVE
28TH AVE
34TH AVE
40TH AVE
LINCOLN RD
SOUTHERN RR
Gordon Creek
-N-

FIGURE 1

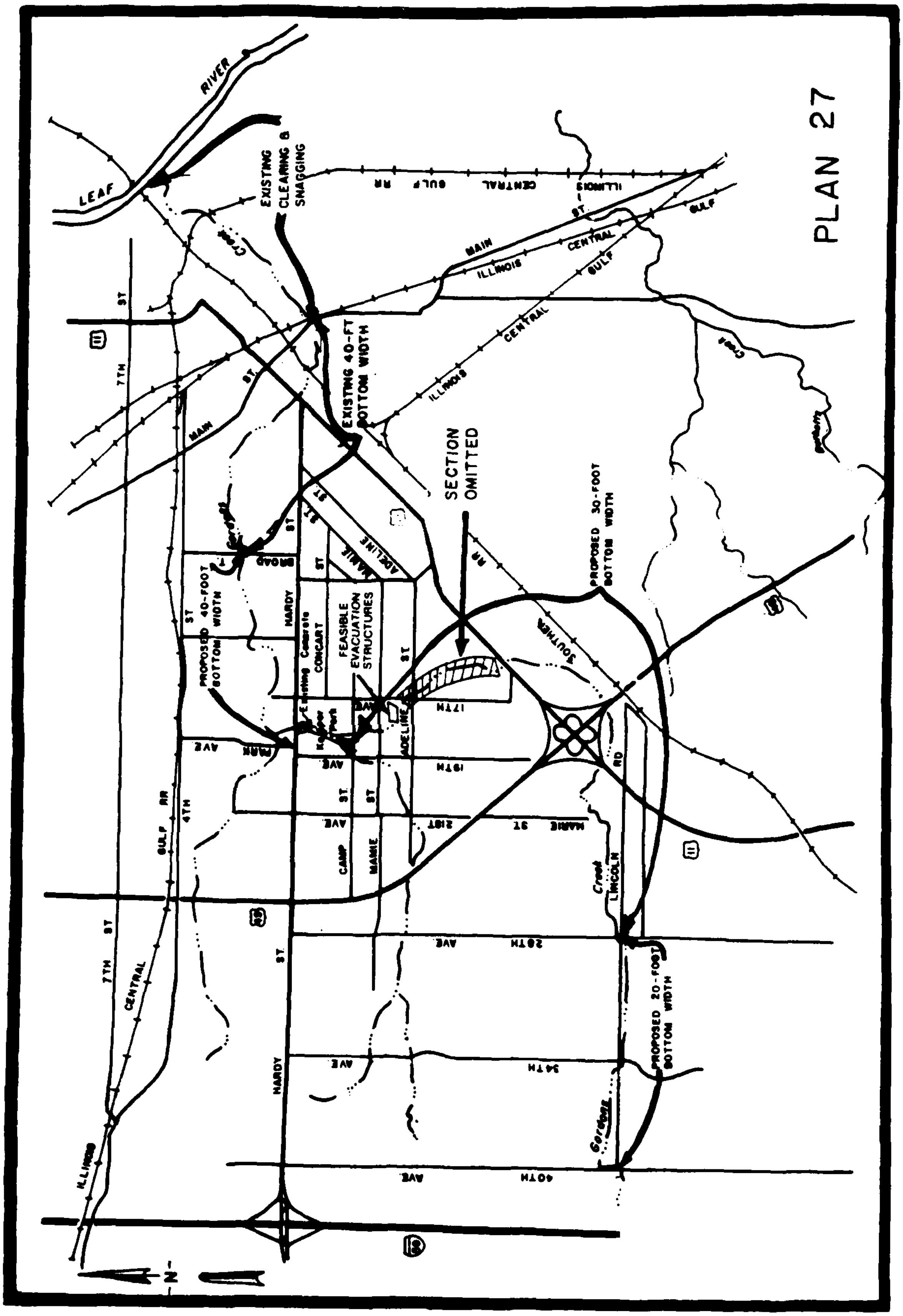

PLAN 27
LEAF RIVER
EXISTING CLEARING & SNAGGING
EXISTING 40-FT BOTTOM WIDTH
SECTION OMITTED
PROPOSED 30-FOOT BOTTOM WIDTH
PROPOSED 40-FOOT BOTTOM WIDTH
FEASIBLE EVACUATION STRUCTURES
PROPOSED 20-FOOT BOTTOM WIDTH
ILLINOIS CENTRAL GULF RR
MAIN ST
7TH ST
HARDY ST
N

FIGURE 2

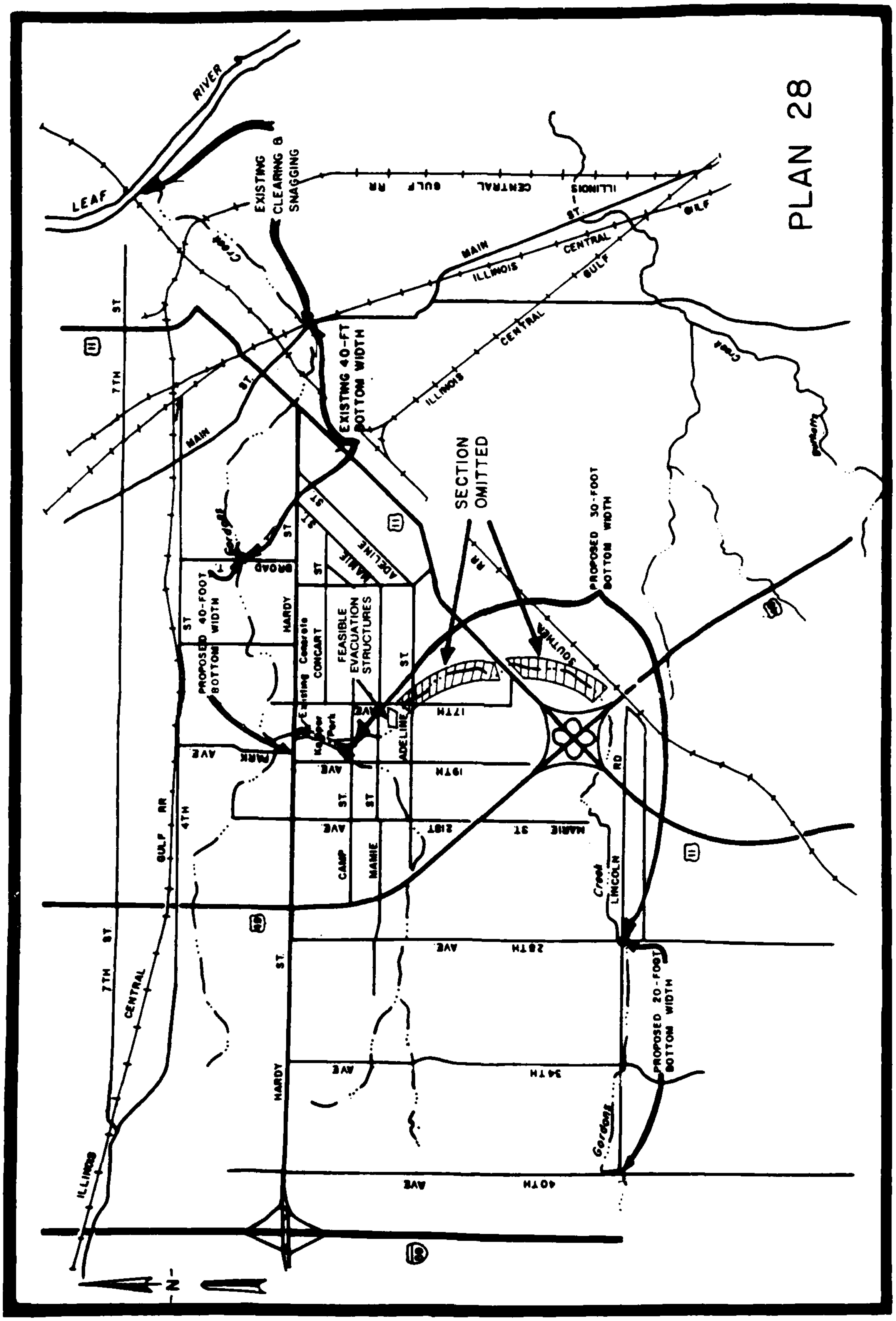

PLAN 28
LEAF RIVER
EXISTING CLEARING & SNAGGING
EXISTING 40-FT BOTTOM WIDTH
SECTION OMITTED
PROPOSED 30-FOOT BOTTOM WIDTH
PROPOSED 40-FOOT BOTTOM WIDTH
FEASIBLE EVACUATION STRUCTURES
Existing Concrete
PROPOSED 20-FOOT BOTTOM WIDTH
ILLINOIS CENTRAL GULF RR
MAIN ST.
7TH ST
4TH
HARDY ST.
ADELINE
MAMIE ST
CAMP AVE
BROAD
PARK AVE
17TH
19TH
21ST AVE
28TH AVE
34TH AVE
40TH AVE
LINCOLN RD
SOUTHERN RR
N

FIGURE 3

A comparison of Plans 24B, 27, and 28 is shown in Table 1. Table 1 is similar to a table shown in the January 1985 Workshop Brochure. However, in Table 1 the data for Plan 24B is different because of refinements in the plan and changes in price levels for costs and benefits.

TABLE 1
UPPER GORDONS CREEK PLAN FORMULATION RESULTS

PLAN	BENEFITS & COSTS 1/ Benefits	Costs	Net Ben	B/C	DAMAGES 1/ Existing	Remaining	Removed	DAMAGES 1/ Existing	Induced	Resulting
	PROPOSED PLAN SEPARATE FROM THE EXISTING PROJECT							EXISTING PROJECT		
24B	1,084.17	739.18	344.99	1.5	1,426.45	342.28	76.0%	72.65	-27.48	100.13
27	1,021.41	610.75	410.66	1.7	1,426.45	405.04	71.6%	72.65	-27.48	100.13
28	876.22	528.15	348.07	1.7	1,426.45	550.23	61.4%	72.65	-27.48	100.13
	PROPOSED PLAN COMBINED WITH THE EXISTING PROJECT 2/									
24B	1,142.41	760.88	381.53	1.5	1,499.10	356.69	76.2%			41.89
27	1,079.65	632.44	447.21	1.7	1,499.10	419.45	72.0%			41.89
28	934.46	549.83	384.63	1.7	1,499.10	564.64	62.3%			41.89

1/ Benefit, Cost, and Damage Values are shown in thousands of dollars.

2/ Includes mitigation of downstream damages so that the resulting damages would be less than the existing damages.

These additional analysis of alternatives has changed the study findings. From the data in Table 1, Plan 27 provides the greatest net benefits and therefore should be supported for construction. The magnitude of induced damages on the existing project downstream from Broad Street would require mitigation for all three plans. Therefore, the flood proofing of certain structures in this area is still required as reported at the workshop last year.

A detailed cost estimate for Plan 27 is given in Table 2 and an apportionment of costs between Federal and Non-Federal interests is given in Table 3.

TABLE 2

Detailed Cost Estimate for Plan 27
(October 1985 Price Levels)

Item	Quantity	Unit	Unit Cost	Total Cost
		STRUCTURAL COMPONENT		
Project Construction				
Channel Enlargement				
Clearing and Grubbing	28.0	Ac	$1,300.00	$36,400
Disposal Area Clearing	4.4	Ac	1,500.00	6,600
Channel Excavation	170,700	CY	5.56	949,100
Riprap	12,830	CY	50.00	641,500
Bedding Material	4,490	CY	40.00	179,600
Filter Cloth	25,770	SY	3.00	77,300
Seeding and Mulching	28.0	Ac	2,300.00	64,400
Drainage Structures (7)		LS		139,900
Contingencies (20%)		LS		419,000
Total Construction Cost				2,513,800
Engineering and Design (8%)				201,100
Supervision and Administration (6%)				150,800
Total for Channel Enlargement				2,865,700
Total Cost for Project Construction				$2,865,700
Lands, Damages, and Relocations				
Lands and Damages				
Land for Right-of-Way	53.6	Ac	18,680.00	1,005,000
Severance Damages		LS		393,400
Structures to be Removed		LS		348,500 1/
Land for Disposal Areas	8.8	Ac	2,000.00	17,600
Contingencies (20%)		LS		352,900
Administrative Costs	139	Ea	4,000.00	556,000
Total for Lands and Damages				2,673,400
Relocations				
Bridge Modifications (2)		LS		216,800
Electric Lines		LS		2,200
Pipelines (18)		LS		80,200
Contingencies (20%)		LS		59,800
Total for Relocations				359,000
Total Cost for Lands, Damages, and Relocations				$3,032,400

TABLE 2 (Continued)

Detailed Cost Estimate for Plan 27
(October 1985 Price Levels)

Item	Quantity	Unit	Unit Cost	Total Cost
NONSTRUCTURAL COMPONENT				
Flood Plain Evacuation				
Property Acquisition				
Value of Land				
and Structures	8	Ea	Varies	$275,200
Contingencies (20%)		LS		55,000
Administrative Costs	8	Ea	$4,000.00	32,000
Total for Property Acquisition				$362,200
Demolition and Site Reclamation				
Remove Structures	8	Ea	1,500.00	12,000
Remove Utilities	8	Ea	800.00	6,400
Grade and Grass Site	8	Ea	500.00	4,000
Contingencies (20%)		LS		4,400
Total for Demolition and Site Reclamation				$26,800
Salvageable Items	8	Ea	(5,000.00)	(40,000)
Total Cost for Flood Plain Evacuation				$349,000

TABLE 2 (Continued)

Detailed Cost Estimate for Plan 27
(October 1985 Price Levels)

Item	Quantity	Unit	Unit Cost	Total Cost
		MITIGATION COMPONENT		
Habitat Mitigation				
Land for Right-of-Way	3.7	Ac	$18,680.00	$69,100
Tree Plantings		LS		12,000
Contingencies (20%)		LS		16,200
				1,074,100
Total Cost for Habitat Mitigation				97,300
Mitigation of Induced Flood Damages				
Raising Structures in Place				
Elevating the Structure	21	Ea	$2,100.00	$44,100
Foundation Work	21	Ea	2,000.00	42,000
Landscaping	21	Ea	1,000.00	21,000
Temporary Housing	21	Ea	500.00	10,500
Subtotal for Raising Structures in Place				117,600
Sealing One Structure				
Concrete	133.0	CY	200.00	26,600
Excavation	800	CY	5.50	4,400
Earth Fill	800	CY	6.50	5,200
Interior Drainage		LS		600
Sewer Modifications		LS		500
Landscaping		LS		1,500
Subtotal for Sealing One Structure				38,800
Contingencies (25%)				39,100
Total Construction Cost				195,500
Engineering and Design (10%)				19,500
Supervision and Administration (8%)				15,600
Total Cost for Mitigation of Induced Flood Damages				230,600
TOTAL COST FOR STRUCTURAL COMPONENT				**$5,898,100**
TOTAL COST FOR NONSTRUCTURAL COMPONENT				**$349,000**
TOTAL COST FOR MITIGATION COMPONENT				**$327,900**
TOTAL PROJECT FIRST COST				**$6,575,000**

1/ Does not include Relocation Assistance under PL 91-646.

TABLE 3

Cost Apportionment

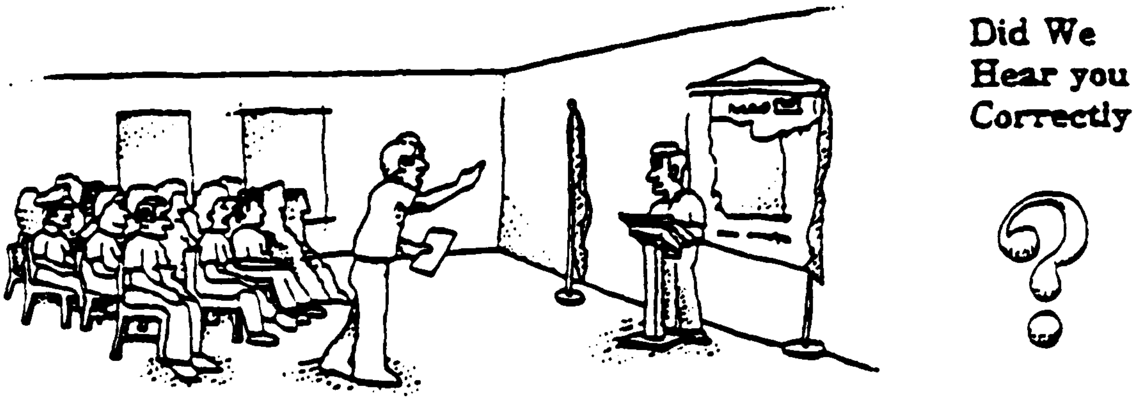
Item	Federal	Non-Federal	Total
Project Construction	$2,537,000	$328,700	$2,865,700
Lands, Damages & Relocations	0	3,032,400	3,032,400
Flood Plain Evacuation	279,200	69,800	349,000
Subtotal	2,816,200	3,430,900	6,247,100
Percentages	45%	55%	100%
Habitat Mitigation	43,900	53,400	97,300
Mit. of Induced Damages	104,000	126,600	230,600
TOTAL PROJECT FIRST COST	$2,964,100	$3,610,900	$6,575,000

FUTURE ACTIONS BY THE CORPS OF ENGINEERS

Plan 27 will be presented as the NED plan and supported for construction in a Final Detailed Project report on Upper Gordons Creek if the local sponsor and others in the area are supportive. At this time, the Final Detailed Project Report is scheduled for completion in September 1986. Expedient processing of the report and approval of the project by the Chief of Engineers, could allow construction to begin in 1987. However, the project must compete for limited funds allocated for similar projects throughout the nation.

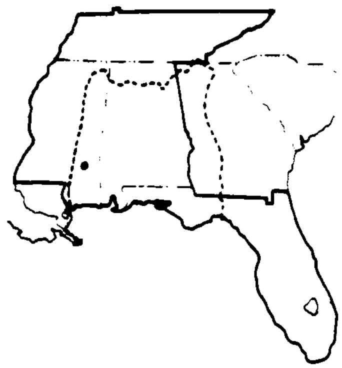
Ernie Seay

Ernie Seay
Study Manager



THIS IS WHAT WE HEARD YOU SAY AT THE WORKSHOP ON GORDONS CREEK HATTIESBURG, MISSISSIPPI

Gordons Creek
Hattiesburg, Mississippi



September 1986

Mobile District

US Army Corps of Engineers
Mobile District

PUBLIC INFORMATION FACT SHEET

STUDY BACKGROUND

The Mobile District of the Corps of Engineers performed a detailed study of the flooding problems in the Gordons Creek drainage basin and presented the study results to the residents along the creek in a workshop in January 1985. The study was conducted under the authority of Section 205 of the 1948 Flood Control Act, as amended. A Draft Detailed Project Report was completed in May 1985 and released for public review in August 1985. The report concluded that Plan 24B was the most practical solution to flood problems in the basin. This plan consists of channel enlargement on the main creek from Broad Street upstream to Hardy Street and from Kamper Park upstream to South 40th Avenue.

Subsequently, the City of Hattiesburg requested additional studies on the project and consideration of a solution smaller in scope than Plan 24B.

PURPOSE OF THIS FACT SHEET

The Mobile District has completed the analysis of additional alternatives for Upper Gordons Creek. A new plan, identified as Plan 27, has been found to be better than Plan 24B. Plan 27 reduces construction costs and increases net benefits of the work when compared to Plan 24B. The plan consists of channel enlargement from Broad Street upstream to Hardy Street and from Broadway Drive upstream to South 40th Avenue. The channel work would have the same dimensions as Plan 24B. For the portion of stream from Kamper Park upstream to Broadway Drive, nine residences would be purchased and removed from the flood plain.

On July 15, 1986, a Public Workshop was held in the Jackie Dole Community Center, 222 Front Street, Hattiesburg, Mississippi. The purpose of the workshop was to present the new study results and to determine local views concerning this new plan. A Public Information Brochure describing the study results was mailed to affected residents before the workshop and was discussed at the meeting. Questions and comments were received and answers were given during the meeting.

THIS IS WHAT WE HEARD

The comments (C) and questions (Q) received at the workshop along with responses (R) are as follows:

C A representative for the residents on Brooklane Street and South 17th Avenue stated that they are ready to move.

Q In the area where the houses are to be evacuated, how do you propose to finish the bank and maintain it when the houses are gone?

R No work is planned in the stream in this reach. The houses, utilities, foundations, and any other improvements will be removed. The lots will then be graded and grassed. The area will be mowed at least once a year, when maintenance on the overall project is performed.

Q Will the area be mowed only once a year? We are concerned about how it will look. Would there be a fence?

R Once a year would be a minimum requirement. The Corps' concern will be to make sure the project functions as designed. An annual inspection will be made to insure that vegetation does not obstruct flood flows. However, specific details of the maintenance program will be the responsibility of the sponsor. Any fences or any other uses of the property would also be determined by the sponsor so long as flood flows are not obstructed.

Q At Adeline Street, upstream of the bridge, the stream is changing course and is cutting into the west bank. I know you are not planning to do anything is this area. Has this erosion been taken into consideration? The stream is also eroding a yard downstream of the bridge. Will anything be done there?

R No work is planned for this area. Bank erosion in this reach of stream has been determined to be minor and the cost of repairs far exceeds the benefits to be gained.

Q Isn't the project going to make conditions worse in this area?

R Our studies indicate that the velocity of flows experienced in the past will not be significantly changed by the project, and erosion should not be worse than in the past.

Q Why can't the Corps spend a little more to help the people with erosion problems in this area?

R The benefits for doing the work must exceed the cost and that is not the case in this area.

C A narrow channel and trash collecting at a downstream bridge caused problems by increasing flooding in the Adeline Street area during the flood in 1983.

R The April 1983 flood was larger than the 100-year flood for most areas along the creek. For a storm that large, the collection of trash on a bridge is an emergency condition that cannot be anticipated and prevented. This project is one that reduces damages and is worth the investment but does not prevent the kind of flooding experienced in 1983. The narrow channel and bridge opening is a problem that cannot be solved under the Federal requirement that benefits must exceed costs.

Q Are you mainly concerned with the 100-year flood? Most of us won't be here in a hundred years!

R The expression "100-year flood" indicates the magnitude of a particular flood and not the length of time between each occurrence. A 100-year flood can occur at any time. A better description of the flood might be one that has a one percent chance of occuring in any year.

C I would like to ask the Corps to consider enlarging the approach to the bridge and providing riprap for the banks in the vicinity for the bridge at Adeline Street on the main creek and for the bridge at Adeline Street and South 21th Avenue on the tributary.

C Part of the City's request for modification of the project was to look at the approaches of bridges in this area and to do some modification work and provide riprap.

R The benefits for work to prevent damage to stream banks and yards are much less than for work to reduce damages to homes and furniture. Our studies indicate that although minor shaping would be beneficial, the impact on damages to structures is too small to justify the work. We have also found that, at this time, bank erosion in this area is not severe and existing conditions are not significantly altered by the project. Therefore, riprap protection is not a part of our plan. If we find a need for additional riprap during detailed design of the project, we will have the opportunity to include it.

Q What does the term mitigation of downstream damages mean?

R Mitigation means to compensate, offset or reduce these impacts. Because 23 structures downstream of Broad Street would be flooded worse with the project, mitigation is required.

Q Where would the downstream damages be located?

R The area extends from Broad Street downstream to Green Street. Farther downstream, in the common flood plain for Gordons Creek and the Leaf River, there is no change in flood conditions with the project.

C Riprap with channelization does not do any good because the riprap washes away and does not prevent erosion.

R Sometimes that occurs and damage to riprap should be repaired under the normal maintenance program for the project.

C There is no way in the plans (in the brochure) to do anything about maintenance.

R The operation and maintenance program is not described in the brochure. However, operation and maintenance is included in the project report which has been circulated for public review.

C One participant stated that at West Street, riprap in the creek and a pipe on the bridge increased the flooding in the vicinity during the 1983 flood. He also said that the existing project is not being properly maintained. He gave us pictures of debris in the creek and stated that the size of some willow trees in the steam indicate more than one year's growth.

R The last annual inspection of the existing project was in December 1985. At that time we found riprap that was not properly maintained, erosion in certain areas that should be repaired, and shoaling, debris and vegetation in the stream that should be removed. The local sponsor has been notified of the deficiencies.

Q When will work begin on removing the eight homes on Brooklane Street and South 17th Avenue?

R If approval of the project, cost sharing arrangements with the local sponsor, and detailed design proceed in a normal manner, work to purchase the homes could begin in approximately one year.

Q What will be the schedule for work upstream of South 34th Avenue?

R Current plans are to proceed with work downstream of Broadway Drive as quickly as possible. Upstream of Broadway, work would begin in three or four years depending on the time required to raise local funds and acquire rights-of-way.

Q Are you saying that work will not start in this area for another three or four years?

R That is very likely.

Q Will the Corps have any more meetings like this before work begins on the project?

R No further meetings are planned at this time.

Q When the project is in final design, will consideration be given to changing the three on one channel side slopes in areas where there are houses close to the creek on both sides?

R Yes. During final design, additional soils investigations would be done and steeper side slopes installed if it is safe and less expensive.

Q Will the homes near the intersection of South 34th Avenue and Lincoln Road which are in the right-of-way of the proposed plan still be removed by the project?

R Yes. These homes are in the right-of-way of the proposed plan.

Q Would the project be totally approved as far as Federal funds are concerned and then be contingent upon local funds becoming available?

R Yes. When we agree to proceed with the project with the local sponsor, the agreement would be for the total project and not just the downstream portion.

Q Does this plan take into consideration the difference between flash flooding and backwater flooding of the Leaf River for the downstream portion of the stream?

R The flood analysis was made on a worse case condition. Backwater flooding on the Leaf River was assumed to be present for both existing conditions and with the plan installed.

Q What would be the difference if backwater flooding is not there on the Leaf?

R The benefits for the plan would be more than we are claiming near the mouth of Gordons Creek. These additional benefits will not be included in our analysis of Plan 27.

Q Did you evaluate the plan with no backwater from the Leaf River?

R No. This analysis was not made since these additional benefits are not appropriate under our evaluation criteria and cannot be included in the project feasibility determination.

Q The brochure shows enlarging Gordons Creek with various bottom widths from Broad Street to the upstream end. Where are the measurements of the depth of the excavated channel?

R The excavated channel will follow the existing channel bottom. The work consists of widening and shaping the sides.

WHAT HAPPENS NEXT?

At this time we intend to recommend construction of Plan 27 to reduce flood damages in the Gordons Creek basin. The next step in the study is to complete the Final Detailed Project Report. The report is scheduled for completion in September 1986. With approval and further funding, plans and specifications could be completed early next year. However, the project must compete with other projects throughout the nation for limited funds.

We appreciate your participation in the workshop, and for providing your views on the study and its findings. Please feel free to express your views to local officials and the Corps as you see the need.

Ernie Seay

Ernie Seay
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Executive Director
Soil Conservation Society of America
7515 N.E. Ankey Road
Ankeny, IA 50021

Ms. Carolyn Morillo
Orleans Audubon Society
1919 Pine Street
New Orleans, Louisiana 70119

President
Ecology Center of Louisiana
Post Office Box 19344
New Orleans, Louisiana 70179

Chairman
Sierra Club
Delta Chapter
111 South Hennessey Street
New Orleans, Louisiana 70119

Executive Director
Columbus-Lowndes Chamber of Commerce
Post Office Box 1016
Columbus, Mississippi 39701

Executive Director
Environmental Research Group
Route 3, Box 123
Ocean Springs, Mississippi 39564

Mississippi Chapter of the Sierra Club
c/o Mr. Ron Lewis, President
Post Office Box 1151
Oxford, Mississippi 38655

Mississippi Chapter of the Wildlife Society
Post Office Box 1784
Tupelo, Mississippi 38801

Mississippi Forestry Association
201 Realtors Building
Jackson, Mississippi 39201

REPORT COORDINATION LIST

MISSISSIPPI
ORGANIZED SPECIAL INTEREST (Cont)

Mrs. William Amand
Mississippi League of Women Voters
Route 4, Box 226
Ocean Springs, Mississippi 39564

Executive Director
Mississippi Wildlife Federation
Post Office Box 1814
Jackson, Mississippi 39205

Mr. Chester A. McConnell
Southeast Representative
Wildlife Management Institute
Route 6, Box 128A, Wildwoods
Laurenceburg, Tennessee 38464

Student Chapter of the Wildlife Society
c/o Department of Wildlife and Fisheries
Post Office Box LW
Mississippi State, MS 39762

Environmental Defense Fund
444 Park Avenue South, 9th Floor
New York, New York 10016

National Audubon Society
Southeast Regional Office
Southeast Region
Post Office Box 1268
Charleston, South Carolina 29402

Tenn-Tom Wildlife Council, Inc.
Post Office Box 2635
Columbus, Mississippi 39701

Tombigbee River Conservation Council
c/o Mrs. Donna L. Rushing
319 Stonewall
West Point, MS 39773

Tally Riddel, Jr.
Tupelo Chapter of Ducks Unlimited
Post Office Box 789
Tupelo, Mississippi 38801

Mr. Robert R. Reid, Jr.
1400 Park Place Tower
Birmingham, Alabama 35203

Mr. David J. Vann
Carlton, Vann, and Stichweh
Attorneys at Law
903 Frank Nelson Building
Birmingham, Alabama 35203-2669

United States Department of Agriculture
Soil Conservation Service
1321 Federal Building
100 West Capitol Street
Jackson, MS 39269

August 29, 1985

Mr. Lawrence R. Green
Chief, Planning Division
Mobile District
Corps of Engineers
P. O. Box 2288
Mobile, Alabama 36628

Attention: Western Basins Branch

Dear Larry:

The draft Detailed Project Report, dated May 1985, on studies performed for flood control along Upper Gordons Creek was reviewed. The selected plan provides for an excavated channel (enlargement) along 4.7 miles of Upper Gordens Creek in Hattiesburg, Mississippi. This proposed plan is an extension of an existing Federal project for flood damage reduction on Gordons Creek from the mouth upstream 2.5 miles to Broad Street. The entire area is primarily urban.

The draft describes the selected plan and other plans considered and contains an environmental assessment, unsigned Finding of No Significant Impact and Section 404 (b)(1) Evaluation for the project. Impacts of the plan are documented.

We have no comments on the plan except that it should, when installed, improve the area. We appreciate the opportunity to review the document.

Sincerely,

Acting

A. E. Sullivan
State Conservationist

cc: David P. Anderson, Assistant State Conservationist, SCS, Jackson, MS
Lewis R. Watts, Area Conservationist, SCS, Hattiesburg, MS

STATE OF MISSISSIPPI
DEPARTMENT OF ARCHIVES AND HISTORY
P O BOX 571
JACKSON, MISSISSIPPI 39205-0571

August 30, 1985

Mr. Lawrence R. Green
Chief, Planning Division
Mobile District, Corps of Engineers
Post Office Box 2288
Mobile, AL 36628

RE: Draft Detailed Project Report and Enviromental Assessment on Upper Gordons Creek (May 1985).

Dear Mr. Green:

We have reviewed the above report and assessment and concur with the findings on page 4-24 (Appendix 4: Environment Investigations).

We appreciate having this opportunity to comment.

Sincerely,

ELBERT R. HILLIARD
State Historic Preservation Officer

Roger G. Walker

BY: ROGER G. WALKER
Interagency Coordinator

RGW/sp

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET
ATLANTA, GEORGIA 30365

SEP 0 6 1985

4PM-EA/GM

Lawrence R. Green
Chief, Planning Division
Mobile District Corps of Engineers
P.O. Box 2288
Mobile, Alabama 36628

Dear Mr. Green:

We have reviewed the Environmental Assessment and Finding of No Significant Impact for the Upper Gordons Creek in Hattiesburg, Mississippi and agree with your agency's Finding of No Significant Impact for this facility.

If we can be of further assistance, please do not hesitate to call.

Sincerely yours,

For Gerald J. Miller

Sheppard N. Moore, Chief
NEPA Review Staff
Environmental Assessment Branch

Zack Stewart
Northern District Commissioner

Sam W. Waggoner
Central District Commissioner

Bob Joiner
Southern District Commissioner

STATE HIGHWAY DEPARTMENT
MISSISSIPPI

John R. Tabb
Director

James D. Quin
Chief Engineer

Mississippi State Highway Department/P. O. Box 1850/Jackson, Mississippi 39215-1850

September 11, 1985

Mr. Lawrence R. Green
Chief, Planning Division
U. S. Department of the Army
Mobile District, Corps of Engineers
P. O. Box 2288
Mobile, Alabama 36628

Dear Mr. Green:

Subject: DRAFT - Detailed Project Report and Environmental Assessment on Upper Gordons Creek

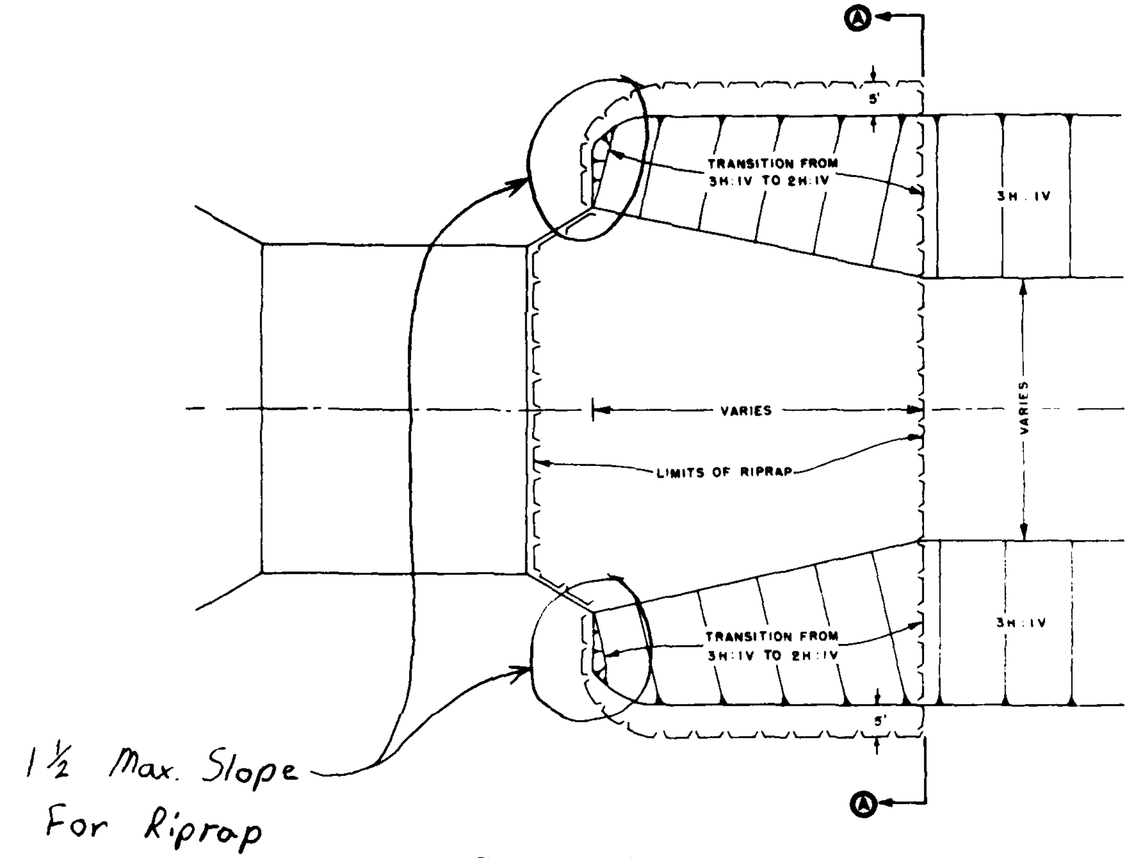
Following a review of the above referenced report, we are advising that the proposed work could possibly adversely impact drainage structures located on U.S. Highway 11 and U.S. Highway 49.

We request that the fill material behind the culvert wingwall be protected from erosion by insuring that the indicated slopes (circled on the attached print) are no steeper than 1.5:1 to accommodate the placement of riprap.

The project will possibly cause bank and channel instability on two tributaries to Gordons Creek. The proposed project does not indicate any protection for these two sites. We request that the site of the 18 x 8 box under U.S. 49 near Forrest General Hospital and the other site of a double 12 x 8 box under U.S. 11 south of the U.S. 49 interchange be protected as a part of this project.

Yours very truly,

CHIEF ENGINEER
JDQ:GC:mck
Attachment



TYPICAL TRANSITION TO BRIDGE CULVERT

NOT TO SCALE

Attachment

RESPONSE TO COMMENTS
FROM THE MISSISSIPPI STATE HIGHWAY DEPARTMENT
ON
UPPER GORDONS CREEK AT HATTIESBURG, MISSISSIPPI
DRAFT SECTION 205 DETAILED PROJECT REPORT

1. Fill material behind culvert wingwalls will be no steeper than 1-1/2 to 1 as requested.

2. The 18 x 8 box culvert under U.S. Highway 49 near Forrest General Hospital is on a tributary of Gordons Creek which will not be modified by the project. The effects of channel works on the main creek are attenuated to existing conditions at the culvert which is about one mile upstream from the nearest proposed channel work. Riprap protection is not needed.

3. The double 12 x 8 box culvert under U.S. Highway 11 south of the U.S. Highway 49 interchange is also on a tributary of Gordons Creek which will not be modified by the project. The project contains a major drainage structure at the mouth of the tributary. The structure will be designed to maintain existing stage-discharge relationships at the culvert. Riprap protection is not needed.

Mississippi Power Company
420 West Pine Street
Post Office Box 1271
Hattiesburg, Mississippi 39401
Telephone 601 545-4000

A. David Williams
General Manager, Hattiesburg District

the southern electric system

September 12, 1985

Mr. Lawrence R. Green
Chief, Planning Division
Department of the Army
Mobile District Corps of Engineers
P. O. Box 2288
Mobile, AL 36628

Dear Mr. Green:

In reference to the **Upper Gordon Creek's Project** in Hattiesburg, Mississippi, there will be a conflict with the proposed project with Mississippi Power Company's lines from approximately Station #253 plus 00 to Station #275 plus 75. This area is located behind the Peddler's Inn on Broadway Drive.

We must be provided a right-of-way and easements to our our specifications prior to our beginning design for relocation of the above-stated line. We will require reimbursement of actual expenses for the relocation.

We will work with you in this matter. The contact for this project is Mr. Charles Evans, Supervising Engineer, Mississippi Power Company, P. O. Box 1271, Hattiesburg, MS 39401; telephone - (601) 545-4124.

Sincerely,

David Williams

DW:sm

cc: Mr. Richard Stone
Mr. Charles Evans

United States Department of the Interior

FISH AND WILDLIFE SERVICE
P.O. Drawer 1190
Daphne, AL 36526

September 16, 1985

Colonel C. Hilton Dunn
U.S. Army Corps of Engineers
P.O. Box 2288
Mobile, Alabama 36628

Dear Colonel Dunn:

The Fish and Wildlife Service (FWS) has reviewed the Draft Detailed Project Report and Environmental Assessment on Upper Gordons Creek and has the following comments.

Specific Comments

EA-3, Para. 3. The list of species in the second sentence also contains reptiles and should be changed to reflect this.

Summary Comments. The FWS is encouraged that adequate mitigative features have been incorporated into the plan to compensate for fish and wildlife resources adversely affected by the project. We believe that this project demonstrates the results of a cooperative approach to conserving fish and wildlife resources.

Sincerely yours,

Larry E. Goldman
Field Supervisor

cc: AHR, Atlanta, GA
EPA, Atlanta, GA
ADCNR, Montgomery, AL
ADEM, Montgomery, AL

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Washington, D.C. 20230

OFFICE OF THE ADMINISTRATOR

September 16, 1985

Mr. Willis E. Ruland
Chief, Environment and Resources
Branch
Department of the Army
Mobile District, COE
P.O. Box 2288
Mobile, Alabama 36628-0001

Dear Mr. Ruland:

This is in reference to the Draft Detailed Project Report and Environmental Assessment on Upper Gordon's Creek, Hattiesburg, Mississippi. Enclosed are comments from the National Oceanic and Atmospheric Administration.

We hope our comments will assist you. Thank you for giving us an opportunity to review the document.

Sincerely,

David Cottingham

David Cottingham
Ecology and Conservation Division

Enclosure

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL WEATHER SERVICE
Silver Spring, Md. 20910

1985

W/OHx2:SZ

TO: PP2 - David Cottingham

FROM: W - Richard E. Hallgren

SUBJECT: Draft Detailed Project Report and Environmental Assessment on Upper Gordon's Creek, Hattiesburg, Mississippi

We have reviewed the draft report and disagree with the proposed solution. On pages 10 and 11 of the report are summarized the plan formulation results for each alternative considered. The flood warning system is listed as a standalone alternative and is considered to be not a practical solution. Numerous studies have shown the high benefit to cost ratio of local flood warning systems. The CoE itself recently has embarked on a program to use these in some areas of the southeastern U.S.

We have cited in several responses to flood studies the need to enfold flood warning systems and network enhancements into every flood reduction study. I strongly recommend DoC ask the Corps to do so in this study.

In a broader sense, I recognize each of these studies is done by a different District or Division in the Corps. Thus, the response to our recommendations is handled differently; and I am sure one response or criticism is not reconsidered even by the same District when a new study is initiated. This lack of continuity of ideas across the Corps' organizational areas and in time is inadvertently reinforced by our own piecemeal approach to the review process. Of necessity, we deal with these studies as they come to us.

The National Weather Service is committed to the use of local flood warning systems and the augmentation of data networks whenever possible. In addition, we are searching for mechanisms to enhance our precipitation networks through cooperative means in keeping with the Water Resources Forecasting Service initiative. These local networks are important to this process.

I believe the DoC should make clear its commitment to the use of local flood warning systems and networks, and make a strong recommendation to CoE national headquarters that the Corps include these in its flood damage reduction studies as a matter of policy.

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2288
MOBILE, ALABAMA 36628

REPLY TO
ATTENTION OF:
Western Basins Branch

September 25, 1985

Mr. David Cottingham
U. S. Department of Commerce
National Oceanic and Atmospheric
Administration
Ecology and Conservation Division
Washington, D. C. 20230

Dear Mr. Cottingham:

This is in response to your comments furnished September 16, 1985 on our Draft Report on Upper Gordons Creek in Hattiesburg, Mississippi.

Mr. Hallgren of your Agency is correct in his assessment of the need for flood warning systems throughout the southeast, and the Mobile District has been leading the way in the Corps of Engineers in this regard. Serious consideration is given to flood warning as one measure in all of our comprehensive plans for flood damage reduction.

As you probably know we are designing and recommending flood warning systems of the ALERT quality for Village Creek in Birmingham, Alabama with drainage area of 70 square miles; Sowashee Creek in Meridian, Mississippi with drainage area of 85 square miles; Luxapalila Creek in Columbus, Mississippi with drainage area of 795 square miles; and, the Leaf and Bowie Rivers in Hattiesburg, Mississippi with drainage area of 1,760 square miles.

Also, we have considered such flood warning systems for Threemile Creek in Mobile, Alabama with drainage area of 29 square miles; Cribbs Mill Creek in Tuscaloosa, Alabama with drainage area of 12 square miles; and, Upper Gordons Creek in Hattiesburg, Mississippi with drainage area of 10 square miles.

We have found that the best flood warning system available cannot provide adequate warning time for local response in extremely small watersheds. At least, we have not been able to convince the local governments that it is a good item to invest in.

Now, for Hattiesburg and Upper Gordons Creek in particular, the local sponsor, the Pat Harrison Waterway District and the City Engineering Department will receive a system at a cost of 20 percent of the total system cost and 100 percent of the operation and maintenance and replacement cost for Leaf and Bowie Rivers. As they use that system and gain experience, we believe expansion into other small watersheds may be more attractive to them, but at this time we cannot recommend a flood warning system as part of our Upper Gordons Creek project since we must have a local sponsor.

We sincerely appreciate your comments and continually seek sponsorship for appropriate flood damage reduction measures.

Sincerely,

Mason B. O'Bannon (?)
for Lawrence R. Green
Chief, Planning Division

STATE OF MISSISSIPPI
OFFICE OF THE GOVERNOR

Beverly W. Hogan
Executive Director
Federal-State Programs

Sandra B. Irby
Director
Department of Planning and Policy

MEMORANDUM

TO: U.S. Army Corps of Engineers
P.O. Box 2288
Mobile, AL 36628

DATE: September 25, 1985

FROM: STATE CLEARINGHOUSE FOR FEDERAL PROGRAMS

SUBJECT: REVIEW COMMENTS
Activity: Detailed project report and Environmental Assessment on Upper Gordons Creek.

State Application Identifier Number: MS850826-008

Location: Forrest/Southern

Contact: Lawrence P. Green

The State Clearinghouse, in cooperation with state agencies interested or possibly affected, has completed the review process for the activity described above.

INTERGOVERNMENTAL REVIEW PROCESS COMPLIANCE:

( ) We are enclosing the comments received from the state agencies for your consideration and appropriate action. The remaining agencies involved in the review did not have comments or recommendations to offer at this time. A copy of this letter is to be attached to the application as evidence of compliance with Executive Order 12372 review requirements.

( ) Conditional clearance pending Archives and History's approval.

(✓) None of the state agencies involved in the review had comments or recommendations to offer at this time. This concludes the State Clearinghouse review, and we encourage appropriate action as soon as possible. A copy of this letter is to be attached to the application as evidence of compliance with Executive Order 12372 review requirements.

( ) The review of this activity is being extended for a period not to exceed 60 days from the receipt of notification to allow adequate time for review.

COASTAL PROGRAM COMPLIANCE (Coastal area activities only):

( ) The activity has been reviewed and complies with the Mississippi Coastal Program. A consistency certification is to be issued by the Bureau of Marine Resources in accordance with the Coastal Zone Management Act.

( ) The activity has been reviewed and does not comply with the Mississippi Coastal Program.

( ) Not Applicable.

cc: Funding Agency (As requested by agency)

2000 Walter Sillers Building — 500 High Street — Jackson, Mississippi 39201 — (601)359-3150

DATE
FILMED
5-8